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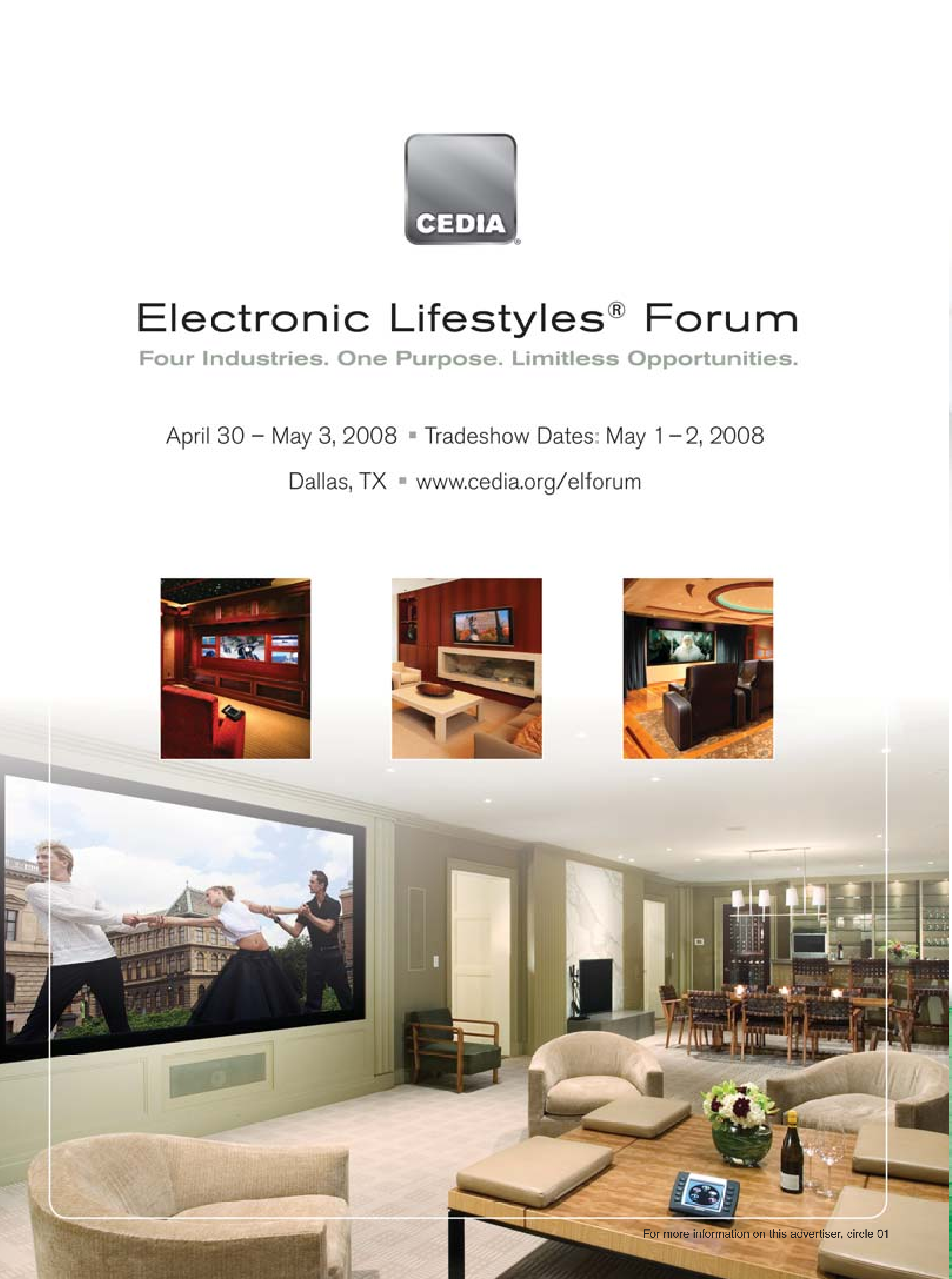
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November/December 2007

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The Optimum Performance Design & Build Resource For Environmentally Enhanced Lifespan Living

VOLUME 2, NUMBER 6, ISSUE 12
November/December 2007

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MISSION STATEMENT

The mission of *Ultimate Home Design* is to serve as a catalyst for homeowners to create demand for architects, designers, and builders to adopt the concepts and building practices that define human-centered, optimum-performance home design. *Ultimate Home Design* is aimed at broadening the segment of the American population that is paying closer attention to the products they buy, looking beyond price and branding to focus on other elements of the production and value chain. Increasingly homeowners want to support sustainable building practices that result in a higher living standard. *Ultimate Home Design* is for those homeowners who want to promote a broader shift in patterns of production and consumption by encouraging practices that better reflect their personal values. We are advocates for using products that reduce energy and use renewable, recycled content or otherwise environmentally preferable materials. An important part of our mission is to promote building practices that result in a substantial reduction in energy use for space conditioning, water heating, lighting, and appliance operation. Another important aspect of our mission is to promote construction practices that improve the indoor environment and reduce the risk of building-related illness. This translates to improved occupant health and comfort by improving thermal comfort; natural lighting and electric illumination; and controlling humidity, odor, noise, and vibration.

Ultimate Home Design is for the thinking homeowner, who wants to be educated and learn about intelligent options for home design, whole-house system design, and comprehensive electronic lifestyle features that can enrich the quality of day-to-day life while reducing the cost of operating a home. With the knowledge gained reading *Ultimate Home Design*, you will be empowered to make intelligent choices about the design and make-up of your home, whether considering remodels or additions, planning a new home, or evaluating an already-built home. *Ultimate Home Design* will explore the wide range of possibilities within the context of designing Optimum Performance Homes™ that integrate universal design architecture; sustainable green building materials and techniques; energy-efficient power systems for electricity, lighting, heating, and air conditioning; water conservation techniques; and comprehensive electronic lifestyle features.

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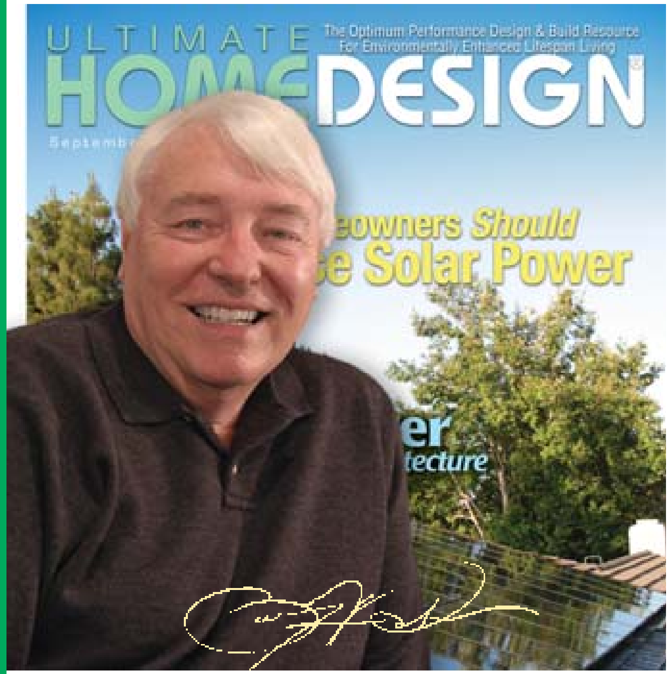

"Green" Is Catching On

In the last issue of *Ultimate Home Design*, we published a number of articles about the various clean energy-generation technologies available to homeowners wanting to build "green." In this issue, Part XII of the ongoing in-depth case study article series focuses on the design of on-site solar, wind, and geothermal energy generation as an integral component of the first Optimum Performance Home™.

The other major theme in this issue is the subject of kitchen and bath design from the standpoint of understanding energy efficiency and water-conservation design and application.

An interview with Rob Zimmerman, Senior Staff Engineer at the Kohler Company, provides insights into Kohler's product development, which continually pushes the performance envelope while transparently saving water. Kohler calls this "conservation without compromise." Kohler offers a range of water-conserving flushing technologies at a variety of price points and in many styles, and consistently scores high with respect to the U.S. Green Building Council's LEED® (Leadership In Energy & Environmental Design) certification standards and Maximum Performance (MaP) testing.

Back in the March/April 2006 issue of *Ultimate Home Design*, we published an introduction to MaP testing of toilet fixtures, including the flushing performance data on 214 different fixture models. Today the North American trend is toward the new High-Efficiency Toilets (HETs). John Koeller and William Gauley provide us with an update on how manufacturers are improving toilet performance through better tank and bowl hydraulics, innovative flush valves, and other measures. They cover the range of HETs now available. An HET is a fixture with an effective flush volume that is at least 20 percent below that of a conventional 1.6-gallon fixture, which is an effective flush volume of 1.28 gallons-per-flush or less. The authors provide suggestions for builders, architects, specifiers, contractors, and consumers to consider when choosing a toilet fixture.

Benjamin Grumbles contributes an article setting forth the new WaterSense™ program , a partnership sponsored by the U.S. environmental Protection Agency (EPA), chartered to help homeowners navigate the waters of efficient plumbing and irrigating practices and products. With more and more eco-branded products entering the market, WaterSense will help you to determine which ones really use fewer resources and perform well.

Jill Abelson revisits the ENERGY STAR® program, a jointly sponsored program by the U.S. Department of Energy (DOE) and the EPA. A primary goal of the ENERGY STAR program is to prevent global warming caused by the inefficient use of energy. The EPA and DOE use the ENERGY STAR mark to recognize and promote the most energy-efficient products within a given category available to consumers.

Richard Karney discusses how homeowners unwittingly throw money away every time they do a load of laundry, open their refrigerator, or run their air conditioner or dishwasher—and provides suggestions for the energy-efficient kitchen by designing kitchens with ENERGY STAR-qualified products.

Mark Johnson contributes an article on the product designs and innovations of Whirlpool Corporation and KitchenAid to achieve energy-efficient kitchen and laundry performance.

While there's even more articles related to "green" inside, I wanted to give a brief report on the recent West Coast Green Residential Building Conference & Expo event in San Francisco.

Nearly 11,000 people registered for the event. The theme of the conferences was "Live The Change." I was most impressed with the three speakers that I heard: Sarah Susanka, Ed Bagley, Jr., and Peter Pfeiffer. I hope to do interviews with these "green" visionaries in the near future. As I reflect on the experience, I spent most of my time meeting with "green" manufacturers and introducing attendees to *Ultimate Home Design* at our booth space on the Expo floor.

An attraction not to be missed was touring the mkLotus™ Showhouse, a prefabricated zero-energy, green-built modular home put up in Civic Center Plaza. Constructed by Xtreme Homes and designed by Michelle Kaufmann, the 700-square-foot house featured numerous sustainable materials.

Please visit www.westcoastgreen.com for more coverage and announcements for next year's event.

Thank you for your support. UHD

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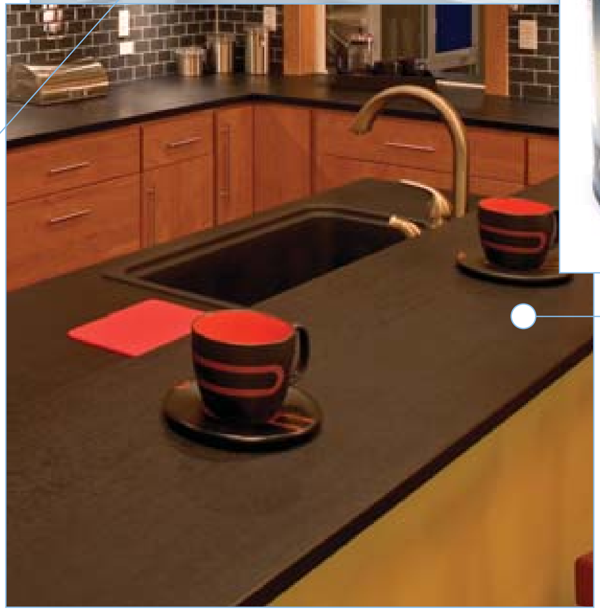
New to the neighborhood

David DelGrosso

Syndecrete® is a sustainable/green, natural, cement-based composite that is half the weight and has twice the compressive strength of standard concrete. Specific to kitchen and bath, Syndecrete can be used for a variety of interior and exterior applications such as counter tops, bathtubs, showers, and sinks.

Offered in pre-cast pieces, Syndecrete's unique aesthetic properties include integral pigmentation and aggregates mixed to create distinctive color and texture palettes. It is more resistant to potential chipping and cracking than conventional concrete, tile, and stone, and is more akin to wood than cement-based products.

For more information, visit www.syndecrete.com.



The Allora™ kitchen faucet by **Delta** offers a completely new magnetic closure that joins the pull-down spray to the body of the faucet for a consistently clean look. Now you can enjoy the convenience of a pull-down spray, without the extra step of twisting and locking the spray head into place.

Designed for a broad aesthetic, the Allora combines country couture style with contemporary nuances. Clean lines and smart design provide an updated version of more traditional-looking faucets, effortlessly fitting in with today's increasingly popular casual trends.

For more information, visit Delta at www.deltafaucet.com.

The foundation of **AFM Safecoat®** rests solidly on a "health first" premise. For years they have pioneered the development of exceptionally safe paints and finishes. Now you can experience a whole new dimension of health with the Ayurveda Essence color system.

AFM has worked diligently to create three different micro palettes of colors that easily harmonize with one another. Each micro palette contains a range of colors that are skewed energetically, based on whether the colors are hot or cold, warm or cool, calming or stimulating, uplifting or grounding, moist or dry.

Visit www.afmsafecoat.com/ayurveda for more information.

Chic, durable, and environmentally friendly, **EcoTop** is the newest innovation from award-winning green product creator, Joel Klippert. A bio-composite surface material for countertops, tabletops, floors, and walls, EcoTop adds practical style in both residential and commercial settings.

EcoTop is composed of a 50/50 blend of bamboo fiber—a rapidly renewable resource—and recycled wood fiber salvaged from demolition sites. The smooth texture and sleek lines offer a refined and timeless appearance that truly rivals that of other surface materials, such as engineered or natural stone. Available in seven colors ranging from Snow White to Jet Black, EcoTop surfaces bring versatility to any room of the house.

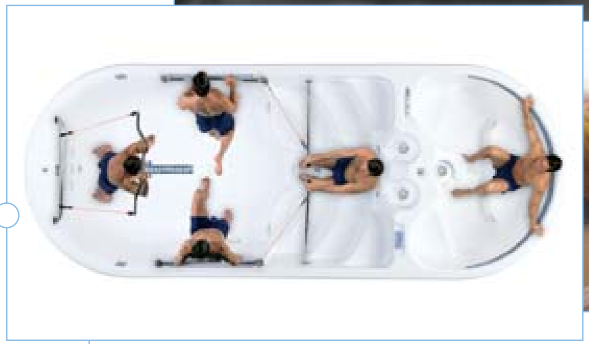
For more information, visit www.kliptech.com/ecotop.html.

In a recent survey, more than half the respondents said they worry that their current dishwasher won't get dishes clean enough. Of those who end up re-washing dishes, the top five reasons are to remove "film" residue on glassware; spots on glasses, silverware, and plates; hard water deposits; un-removed food soil, and re-deposited food soil.

Maytag-brand dishwashers now feature an industry-leading SteamClean option to get glassware clean the first time, every time. Thanks to this high-heat option, the dishwashers remove even the most stubborn residue and spots from glassware, delivering more powerful cleaning performance than ever before. **Whirlpool Corporation**, which acquired the Maytag brand in 2006, is the first in the industry to launch a steam option in dishwashers. Visit www.insideadvantage.com to learn more about Maytag's SteamClean dishwasher option.

Dow Building Solutions has developed a distinct portfolio of integrated solutions that address the entire window and door opening and are fully compatible with each other. When used together, the system is designed to complement and protect windows and doors and the surrounding assemblies and fenestration openings to create an effective seal of protection, helping to prevent unwanted and costly air infiltration and exfiltration.

The portfolio of products offered by Dow Building Solutions exemplifies Dow's commitment to provide technically advanced building materials that enhance the comfort of living and working environments through effective moisture management and energy conservation. For more information, log onto www.insulateyourhome.com.



What is more efficient than a swimming pool, more sophisticated than a hot tub, and safer than a backyard playground? **Dimension One Spa's** revolutionary Aquatic Fitness Systems® is an aquatic exercise machine for the backyard where you can safely swim, walk, run, stretch, row, strength-train, and relax!

Effective and efficient, the AFS swim spa takes up less space than a conventional pool and can be installed inside or outside the home. The 100 percent insulated tub uses a stainless steel heater—providing optimal heat recovery and lower energy consumption. And pure, clean water year-round is easily achieved with an E-Z Lock filter cartridge and the ozone purification system, allowing the owner to use fewer chemicals than most competitive products. For more information, go to www.AquaticFitnessSystems.com.

Saving you money, space, and energy before you draw that first drop of water, **Seisco's RA-28** four-chamber Tankless Water Heater is the company's most popular residential model for the whole house. The very small, powerful, and extremely efficient design considers not only electrical and plumbing requirements of the application, but also space utilization, environment, and potential preheating enhancements, such as heat recovery. The only electric tankless water heater that enjoys a patented power-sharing distribution method for activating the heating elements—to allow each heating element to simultaneously provide substantially equal amounts of heat to the fluid as it flows through the heat exchanger—the RA-28 is available for $809. All Seisco Tankless Water Heaters are tested at the factory just prior to shipping. If you would like to learn more, visit them at www.seisco.com.

More Than Just A Hurricane Proof House

ASHEVILLE, NC—With energy costs rising to astronomical levels, homeowners are looking for any way possible to save money. North Carolina-based Deltec Homes, with their unique home design, has the answer.

Deltec specializes in building round homes, which tests have proven to be about twice as energy efficient as the conventional square or rectangular house. Circular structures require less exterior walls to enclose the living area. This allows for less energy to escape from the house. The aerodynamic nature of the circular design also helps reduce drafts throughout the home, which is one of the biggest reasons for increased energy use. "Some of the same qualities that make our homes so wind resistant also contribute to their high degree of energy efficiency," said Joseph Schlenk, Director of Sales and Marketing for Deltec Homes.

"Our design takes the round, energy-efficient design a step further," Schlenk said. "One example of this is the roof venting system, which is unique to Deltec's design."

The roof design contributes to lower energy use by allowing constant airflow throughout the year. The continuous airflow keeps hot air out of the attic in the summer, reducing the need to cool the house at the level a conventional home requires. The roof system also prevents snow and ice from building up on the roof in the winter, which further reduces heating costs.

The Deltec roof also has an overhang, which keeps out solar energy from the high summer sun and allows solar energy in during the winter when the sun is at a lower angle.

"One of the reasons why we are such believers in the Deltec system is that we used to live in a house that was approximately 1,300 square feet. Our electric bills ranged from $120 to $250 a month," Kim, a Deltec homeowner from Magnolia, Texas, said. "Our Deltec home is almost 4,000 square feet (around three times the size of our old house) and our electric bill averages around $120 to $130 per month. The Deltec home is the best construction you can find."

In addition to the effective design of the homes, the construction method Deltec uses when building homes also contributes to energy conservation. Homes are constructed panel by panel and then shipped off to the building site. Each panel is constructed so they fit together so precisely that air drafts are limited.

"We're real good at making sure that happens," Schlenk added. "We ship homes all over the world so we have to be sure the pieces fit together perfectly."

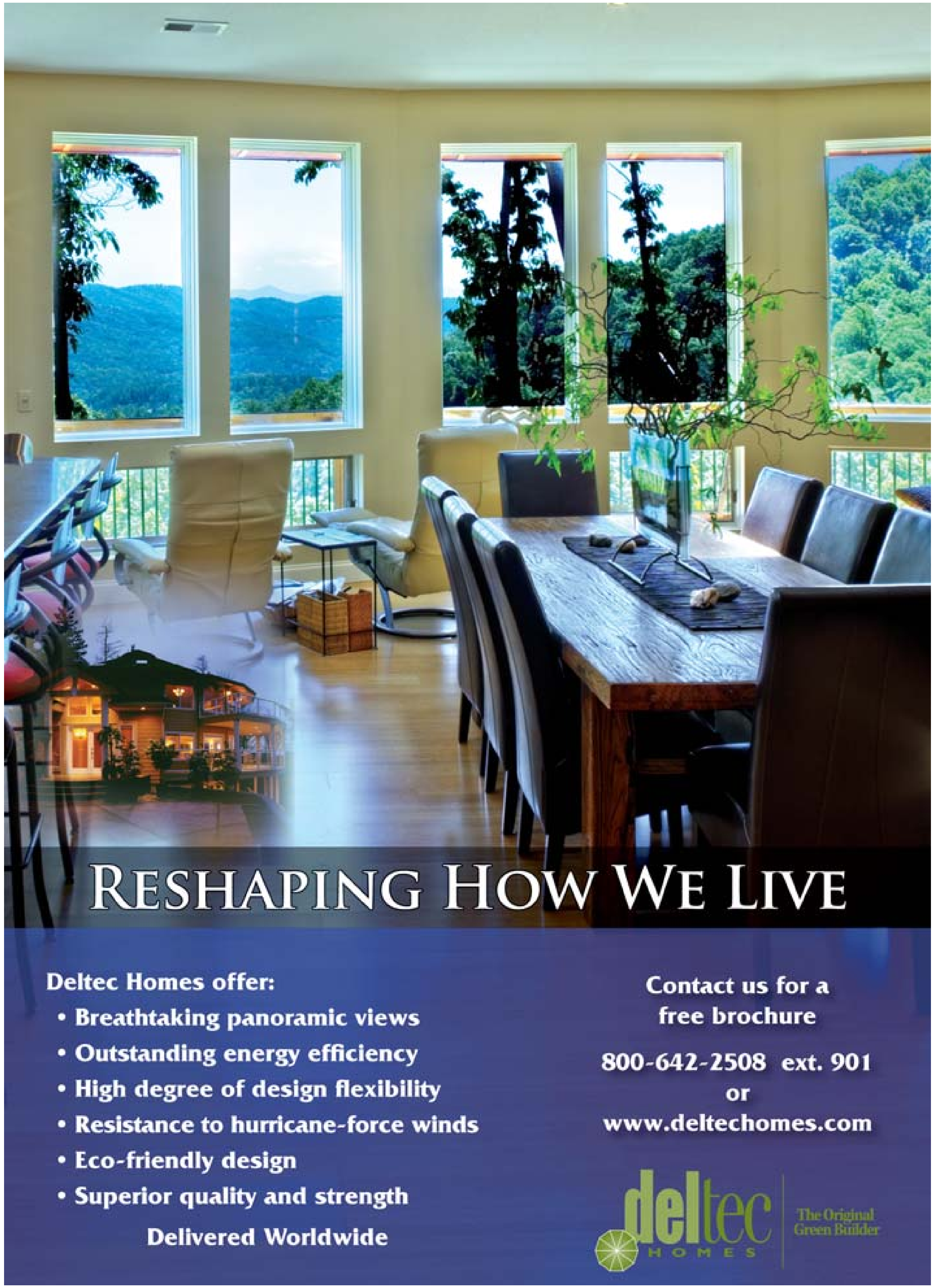
In addition to being a huge energy cost saver, Deltec homes provide numerous other benefits. Among the more important ones is the ability to withstand hurricane-level winds.

As storms battered homes in 2005, Deltec-built houses were able to fight off the winds and survive with no structural damage.

"After Hurricane Katrina we contacted all of our homeowners that were in her path," Schlenk said. "None of the homes suffered any structural damage. Any damage was limited to either minor cosmetic damage or a few missing roof shingles."

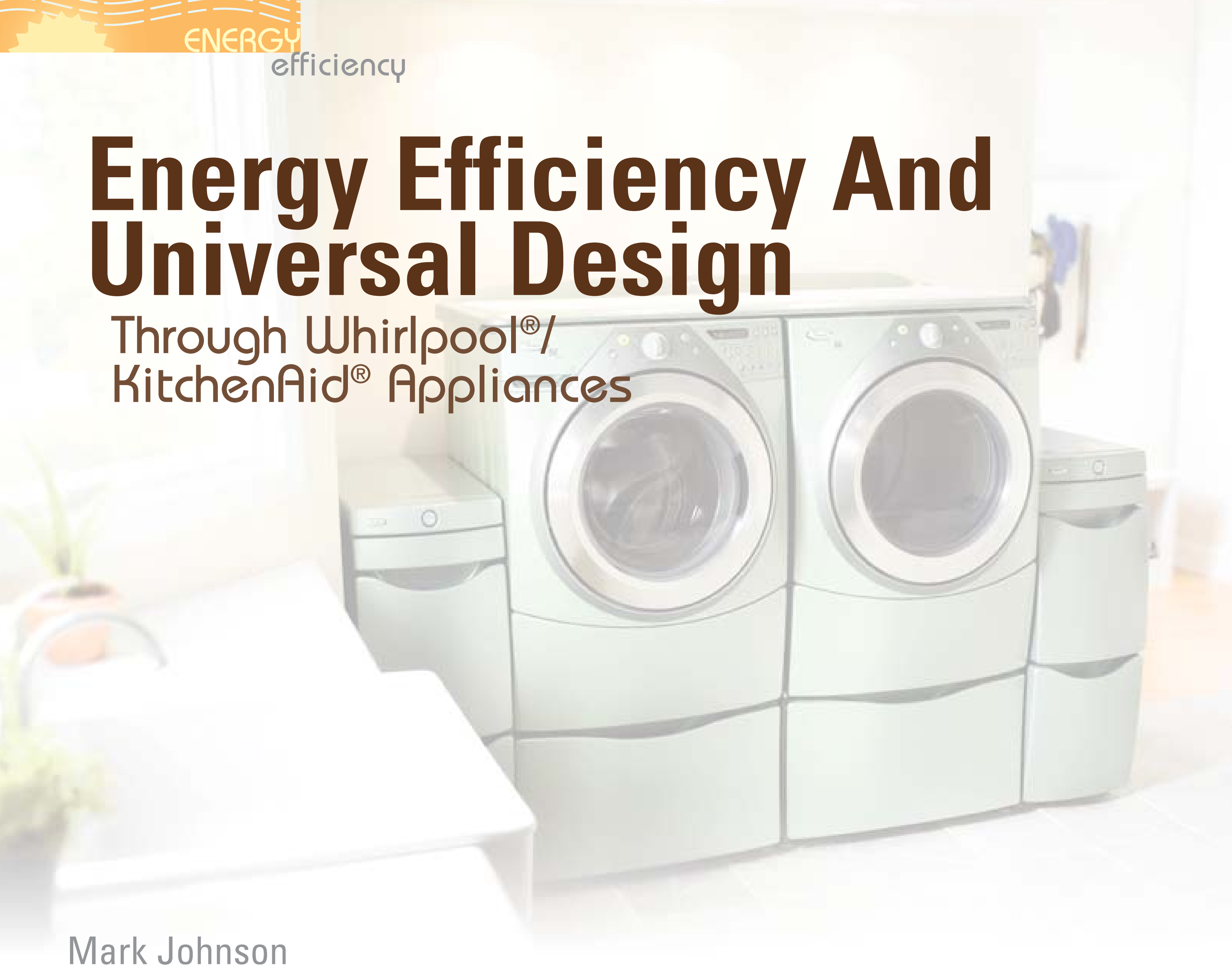
Besides the functional features that make these homes so appealing to homeowners, the houses also have an unmatched visual appeal. The unique design and flexible floor plans allow owners to build their dream home. The plentiful windows frame the spectacular views whether the house is in the mountains or on the water.

"Our design allows the homeowner to customize their home, including having windows where they want," Schlenk said. "There are not many designs that can capture a view the way a Deltec home can. When you consider all of the benefits that our design offers-high wind resistance, energy efficiency, design flexibility and overall quality, and high curb appeal-we feel that we can offer our customers the perfect home."



Energy Efficiency And Universal Design

Through Whirlpool®/ KitchenAid® Appliances



Mark Johnson

synopsis

- The American Council for an Energy-Efficient Economy estimates that if each of us increases the energy efficiency in our major appliances by 10 to 30 percent, it would equal the demand for electricity equivalent to that of 25 large power plants.
- The U.S. Department of Energy (DOE) states that "based on our estimates, a typical family with a home more than a decade old could save $200 a year in electricity and water bills, and 18,600 gallons of water, by switching to highly energy- and water-efficient appliances.
- Energy-efficient appliances are designed to operate at the most accurate power level for the task at hand.

The Need For Energy Efficiency

Over the years manufacturers have readily adopted new technology to create better products. Appliance manufacturers are keyed into consumer trends through market research studies, surveys, and observation. And, interesting, most often consumer demand for that new, improved product will follow. Or is it the other way around? Innovations can be extremely small or fall into the category of "huge." Often the pace can accelerate with those major discoveries, such as when digital first became a viable technology. Changes that evolve around social issues generally move at a much slower place and can even depend on the government tipping the scale one way or the other.

Take energy conservation, for example. The country was well aware of the need for conservation early in the 1970s, when under President Jimmy Carter we experienced an oil crisis. A National Energy Policy and Conservation Act was passed by Congress in 1978, yet little progress in enhancing energy efficiencies in any industry occurred until the late 1980s. And even then, impetus for conservation came through mandated state and then national standards.

The Optimum Performance Home

The twelfth in the series documenting the design and construction of the first Optimum Performance Home™, this article addresses the technology regarding energy efficiencies and universal-design aspects of the home's appliances in meeting the needs of consumers today and tomorrow. The Optimum Performance Home will feature KitchenAid Architect Series II appliances in the kitchen, guest bedroom, home office, and outdoor cooking kitchen, and Whirlpool products in the laundry. Both enterprises are brands of the Whirlpool Corporation, the world's leading manufacturer of major home appliances. The company has received international recognition for "innovation of product design," among other business and social accomplishments.

To ultimately be successful, new products must address current consumer trends, such as energy efficiency and universal design. Advances in technology propel the manufacturer forward. This is a process of evolution—usually a gradual improvement in products, although sometimes a more radical development may present itself and speed up the process. To understand the technology of today's and tomorrow's appliances, therefore, it is more than just examining knobs and digital controls. It's a much broader examination of how and why appliances are used. What follows is a glimpse into some of the issues related to energy conservation and universal design in appliances and the interplay with the manufacturing process plays out over time—and more.

The U.S. Green Building Council selected The Optimum Performance Home for inclusion in the national Leadership in Energy & Environment (LEED®) for Homes pilot project, its new green build certification initiative. The goal is platinum certification.

With the plethora of products in the market and tools for designers, choosing an appliance for a specific project can be confusing and time consuming. Architects and builders are now able to interface more readily with manufacturers' specifications directly via virtual reality. Whirlpool recently added nearly 600 virtual appliance models to the building products area of Google's 3D Warehouse Web site. The warehouse is a repository of 3D building objects that can be easily accessed over the Web, and is particularly useful when working with Google's Sketchup, a software program that provides 3D forms for conceptual stages of design.

Experiencing The Optimum Performance Home

Attend a gathering at the Optimum Performance Home™, and sometime during the evening you will find yourself in the kitchen. It is the heart of the home and a key gathering place for family and friends. Perhaps, as this house will be located at The Sea Ranch, one of Northern California's most unspoiled coastal properties, you'll first congregate outside, yet the kitchen will come into view during the evening. Or will it? The kitchen design is impeccable—a flowing environment of stainless steel, Silestone, slate, and wood. At first, you can't distinguish the various appliances because the style is so consistent throughout, and, quite exquisite. The most telling object may be the gently curving island that overlooks the eating and lounging area where you are headed to get food and drink.

This kitchen represents the state-of-the-art, both in appearance and technology. The setup is indeed elegant, yet there is an inherent simplicity in the layout of the entire space and the design of each element: sink, cabinet, counter, and appliance—at least in appearance. Creating this environment was not easy. Just think of the change over the past decades in the appearance and operation of the typical oven. Grandma's utilitarian cooking area has become a family gathering area for multiple cooks to showcase culinary skills.

At the Optimum Performance Home the appliances and cabinets seamlessly line the kitchen's walls. In turn, the kitchen opens up to an eating and lounge space. This is not the only popular kitchen design approach, for some designers opt for an opposite look—where appliances stand alone and make statements on their own. In general, either aesthetic focuses on clean features with smooth, unbroken surfaces, few crevices, enclosed undersides, and slight ornamental trims or plastic. The trend is to "hide" the technology inside, by virtually placing the operational switches in a discrete location.

Advancing the collective consciousness is a slow process, as perhaps it should be, and the innovation and manufacturing of products is part of it. To make such changes, leaders must be willing to ultimately take risks by embracing new technology.

The need for energy efficiency in appliances is practically a given now, among designers and builders, and has spread to consumers, but not all. Some consumers think the building envelope and the heating and cooling systems consume the most energy in a house. The Environmental Protection Agency, however, has suggested that this represents only 45 percent of a typical home-energy bill, while the remaining 55 percent is attributed to fixtures and appliances of all types and sizes.

Energy-Efficient Appliances

Efficiency has been the buzzword—energy efficiency, water efficiency, material efficiency—in the form of recycling. Now the goal is "green architecture" or sustainable design. Described as meeting the needs of the present without compromising the ability of future generations to meet their own needs, sustainability encompasses the whole environment.

At the same time, we are an aging population, and that is changing product design. A 2000 study suggests that 72 percent of the population aged 45 and over want to "age-in-place." That creates a whole new set of questions and brings to the fore issues surrounding universal design. That philosophy of

Universal And Sustainable Designed Home

Energy Efficient Kitchen

designing products and homes that are useable to the greatest extent possible is gaining a strong hold, but like energy efficiency, adoption of the design principles are long overdue.

The manufacturers' first objective may be to make universal-design appliances as energy- and water-efficient as possible, without sacrificing homeowner comfort. But the ultimate goal is to play a major role within the building and design community to encourage the development of sustainable homes that provide comfortable, efficient, and healthy-living environments."

"Whirlpool Corporation is an industry leader in developing high-performance appliances that help conserve the Earth's resources and allow homeowners to use energy more efficiently. The company continually strives to understand and manage the environmental effects of our business, not only by creating new and innovative products that consume less energy and water, but also by improving our processes and using materials that minimize the impact on our earth," suggest its 2004 annual report.

The American Council for an Energy-Efficient Economy estimates that if each of us increases the energy efficiency in our major appliances by 10 to 30 percent, it would equal the demand for electricity equivalent to that of 25 large power plants. By using energy-efficient products, the average household can save up to $400 a year on utility bills.

The Rocky Mountain Institute also sees reduced carbon dioxide emissions with less appliance energy consumption—most of the electricity generated in the U.S. relies on the burning of fossil fuels, which dumps carbon into the atmosphere, which leads to the greenhouse effect. The Institute observes that if every household in the U.S. replaced old appliances with efficient models, they'd collectively save at least $15 billion per year. At the same time, this would prevent the emission of 175 million tons of carbon dioxide annually.

A real boost to energy efficiency came with the establishment by the U.S. Department of Energy and the Environmental Protection Agency of the ENERGY STAR® program in 1992. The voluntary program established a rating system for building products starting with first labeling computers and monitors before expanding to other industries, including appliances. Many appliance manufacturers suggest that the ENERGY STAR label helps promote and market their units by ensuring consumers that an appliance actually meets or exceeds the requirements of energy-efficiency standards.

For example, the ENERGY STAR-rating on refrigerators indicates the use of high-efficiency compressors, improved insulation, and more precise temperature and defrost mechanism to improve energy efficiency. Qualified models use as least 15 percent less energy than required by current federal standards and approximately 40 percent less energy than conventional models sold in 2001. Replacing a refrigerator bought in 1990 with a new ENERGY STAR-qualified model would save enough energy to light the average household for more than 4-1/2 months.

ENERY STAR-rated dishwashers use less hot water than conventional models, and have washing systems that allow

users to eliminate pre-rinsing and heat drying. Qualified dishwashers use 25 percent less energy than required by the federal minimum standards for energy consumption.

From all reports, the program has been quite successful. According to the Environmental Protection Agency's (EPA) ENERGY STAR Overview of 2005 Achievements report, more than half a million families, 40 percent more than in 2004, now live in ENERGY STAR-qualified new homes and are saving about $110 million annually. Further, builders in more than 40 metropolitan areas now construct 10 percent or more of their new homes as ENERGY STAR, making it easier for prospective home buyers to find a qualified home. Almost 10 percent of new homes constructed in 2005 earned the ENERGY STAR designation.

Basically, energy-efficient appliances are designed to operate at the most accurate power level for the task at hand. Design engineers have risen to the challenge by maximizing the use of electronic and sensing technology. Sensors, DSPs, microcontrollers, power devices, actuators, and flash-memory ICs figure heavily in appliance design. Differentiation is another description in that the advanced electronics has allowed for a more precise registering of task at hand and the corresponding operation of the appliance.

An example is Whirlpool's 6th Sense technology, available throughout Europe, Latin America, and Asia in refrigerators, dishwashers, and ovens. In ovens, sensors determine the weight of the food and the precise temperature inside the cavity to control the process and adapt a cooking time. Refrigerators automatically adjust internal temperatures to keep food fresh. Dishwashers and washing machines modify cleaning cycles and the amount of time, energy, and water needed to clean loads, resulting in clean dishes or clothing, while also conserving energy and water.

Water Conservation

The conservation of water is now on the radar. The western states in the U.S. have struggled with drought conditions in the past, but now experts predict water shortages worldwide. Population rise, global warming, climate change, and pollution are among the causes. Whether you agree or not, water is going to be seen as a much more precious commodity.

Like energy sources, Americans waste a great deal of water in their daily lives. The U.S. Department of Energy (DOE) states that "based on our estimates, a typical family with a home more than a decade old could save $200 a year in electricity and water bills, and 18,600 gallons of water, by switching to highly energy- and water-efficient appliances. If every American household installed these products, the annual water savings would equal the average flow of the Mississippi River into the Gulf of Mexico for five entire days.

Tagged in the push for conservation are the water-consuming home appliances we use every day. Like energy, the goal is to conserve, while maintaining a similar quality of life. And unfortunately, like energy efficiency, Americans are moving slowly on this front also. Earlier efforts have included water-conserving toilets and showerheads, and the eco-friendly recycling of rainwater.

In 2005, Whirlpool introduced the Duet Fabric Care System, front-loading clothes washers and driers, which are designed to "save 69 percent of water compared to average top-loading models over the course of the year," Whirlpool maintains. With 6th Sense technology, the machine can gauge water levels according to load size and cleanliness and control not only water levels but also water temperature. And, as mentioned above, Whirlpool dishwashers are designed to be sensitive to water usage.

Based on the ENERGY STAR program, the EPA and the DOE launched WaterSense℠ in 2006, a voluntary public-private partnership to identify and promote high-performance products and programs that preserve the nation's water supply. For example, WaterSense calls for washing machines to take into account what is known as the modified-energy factor: the higher the modified-energy factor, the more efficient the clothes washer. The factor measures the amount of energy used to remove the remaining moisture content in items being washed.

> "...green architecture" or sustainable design can be described as meeting the needs of the present without compromising the ability of future generations to meet their own needs—sustainability encompasses the whole environment."

Keep in mind that while energy-efficient and water-conserving appliances often have higher costs, the purchase price is only a small part of the life-cycle cost on any appliance—the relative cost of the energy and water required to operate and maintain the appliance over its lifespan can significantly outweigh the initial cost.

The average American family owns half a dozen major appliances. In addition, manufacturers in the U.S. ship nearly

65-million home appliances annually, according to the Association of Home Appliance Manufacturers. These appliances will typically have useful lives of 10 to 16 years. Recycling old appliances is encouraged for scrap steel, for instance, that can be processed and remelted repeatedly to manufacture new products. In 2000 an estimated 41 million appliances reached the end of useful life and over 34 million were sent for recycling or disposal, according to the Steel Recycling Institute. Major home appliances make up about 10 percent of the steel processed by the recycling industry; cars make up 80 percent, and other industrial and commercial scrap the remaining 10 percent.

The chlorofluorocarbons (CFCs) found in the cooling systems of refrigerators and freezers and auto air conditioners were banned in 1994 for use by the Environmental Protection Agency, as it is believed that CFCs harm the Earth's ozone layer. EPA does allow the use of recycled CFCs for repairs in appliances manufactured before the ban.

Universal Design

"Make everything we design and produce usable by everyone to the greatest extent possible," was the philosophy of Ronald Mace, FAIA, the architect who in l970 established the Center for Universal Design at North Carolina State University. This remains the main principle of universal design. In many ways, universal design requires only slight changes in simple things: The shape of an element; its placement or size; the force necessary to operate it; or the way in which the user must interact with the item. When done well, universal should be invisible.

That said, we can relax. It should be easy to find a home that is comfortable and functional regardless of a person's physical limitations. Yet it isn't, as the construction of a home that serves a person well—whether you are 22, 55, or 85—has not yet become an industry standard. Now, however, as our population ages, there is no question that the movement toward universal design in housing and consumer products in becoming more viable.

Consider population trends. By the year 2010, it is expected that one in three Americans will be 50 years or older. And, more than ever before, the population desires to "age in place." The American Association of Retired Persons' 2000 study reported that 72 percent of the population aged 45 and over want to continue to live in their current home. Builders are paying attention and employing universal design features previously regarded useful only by the elderly and disabled: large showers with built-in seats, higher toilets, fewer overhead kitchen wall cabinets, lower closet rods, and higher electrical sockets.

Universal design is a voluntary design philosophy that merges function with style. It seems a common sense approach to design to produce products that are usable by everyone to the greatest extent possible. It should be noted that universal design is not the same as design complying with the Americans with Disabilities Act. A national law, ADA requires that new or renovated buildings open to the public provide reasonable access and functionally to people with physical disabilities. Physical artifacts include ramps and elevators, wider corridors and doors, textured walking surfaces, signs with Braille characters, lower drinking fountains and sinks, grab bars on walls in bathrooms, and audible crossing signals at street intersections.

Universal design is not a code or standard but is based on seven principles developed by Mace at the Center for Universal Design:

- Equitable Use: The design does not disadvantage or stigmatize any group of users.
- Flexibility In Use: The design accommodates a wide range of individual preferences and abilities.
- Simple, Intuitive Use: Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
- Perceptible Information: The design communicates necessary information effectively to the user, regardless of ambient conditions or user's sensory abilities.
- Tolerance For Error: The design minimizes hazards and the adverse consequences of accidental or unintended actions.
- Low Physical Effort: The design can be used efficiency and comfortably, and with a minimum of fatigue.

In appliances, universal design was initially focused on the physically challenged and aging populations. Innovations included touch-tap cooktops, light-touch controls, and controls that provided visual acuity with bigger, brighter numbers. These components easily gained a larger audience, and, in fact, many of the universal design "innovations" in appliances have come to serve varying populations.

Particularly adaptable, the controls that were once hard to see were moved closer to the viewer. Knob shape and size for ease of manipulation has been a huge change. For example, handles have been added on oven racks and on those handles the space between the handle and the door is wide enough for a mitten hand to fit. Universal design, however, goes beyond objects. In some cases, manageability is a goal, leading to a better quality of life. As appliance technology has advanced, so has the effort to maintain and enhance the user interface, making it easily comprehensible.

Sustainable Design

ENERGY STAR has put energy efficiency in the forefront of new construction. The LEED rating system for homes is aimed

at making the concepts, technologies, and materials for sustainability as well known as those for energy efficiency. New homes built to the LEED standards will be designed and constructed to use less energy, less water, fewer materials, and improve indoor air quality through better ventilation, filtration systems, and control of pollutant sources. Like ENERGY STAR and WaterSense, LEED is a "voluntary initiative promoting the transformation of the mainstream home-building industry towards more sustainable practices."

Sustainable design meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable building practices take into consideration such things as the embodied energy and environment impact of building materials, site selection that facilitates the use of mass transportation, decreased automotive use and a sense of community, and the efficient and environmentally sensitive use of water.

The four key components of sustainable design that have bearing upon appliance manufacturing include energy conservation, life-cycle cost, recycled content, and quality of life.

Integrating age-friendly universal design with the best sustainable building practices and thus exerting minimal impact on the environment is the goal of the Optimum Performance Home, a LEED pilot project. The mkLotus™ house, a "green" home designed by Michelle Kaufmann, AIA, of Northern California, was recently on display at the West Coast House Residential Building Conference + Expo. Built by XtremeHOMES, mkLotus is a factory-built, modular house designed with the latest high-performance systems and sustainable materials and methods. The house meets all ENERGY STAR, Built It Green, and LEED standards of excellence in energy efficiency.

The 100 percent solar-generator powered house features a green living roof, LED lighting, green building materials, ENERGY STAR-qualified Whirlpool and KitchenAid brand appliances and seamless indoor/outdoor living. The kitchen features such items as FSC-certified (Forest Stewardship Council) wood cabinetry and KitchenAid Architect Series II appliances. The laundry area features the ENERGY STAR-qualified Whirlpool high-efficiency 24-inch front-load washer and dryer. The pair's washer averages 14.2 gallons in the normal cycle and is rated for only 212-kilowatt-hour (kWh) annual energy use.

A leader in the green design community, Kaufmann's firm has also designed the factory-built Guildehouse, Sunset, Breezehouse, and mkSolaire, as well as custom homes and green communities. "We believe that sustainable, well-designed buildings should be accessible to more people. To achieve this we have simplified our process and chosen off-site modular technology as our only means to create beautiful, eco-friendly homes." Kaufmann said, "Our hope is that, through our practice, we will make it easy for people to build green and live a more sustainable life."

In the design phase, the Kaufmann firm utilized SketchUp to access the Google 3D Warehouse, which is a repository of 3D objects for virtual home design. Google SketchUp is easy-to-use software in which projects can be designed and visualized in 3D. Kaufmann easily found what she needed for the kitchen and laundry space for her sustainable product specifications, as Whirlpool recently posted several collections of virtual energy-efficient and water-efficient 3D models of appliances from the Whirlpool, KitchenAid, Jenn-Air, and GladiatorWorks brands in the "Green Appliance" category of the Google 3D Warehouse. The SketchUp models can be converted into all major CAD products without having to draw designs twice—and kitchen design can be experienced as a "virtual walkthrough."

The initiated can learn the fundamentals of SketchUp through an interactive DVD. SketchUp experts named School-produced podcasts to share tips and tricks for using the software. Whirlpool Corporation has sponsored five episodes of the video podcast titled, "The SketchUp Show: The Whirlpool Corporation Series." This is the first podcast series to qualify for continuing education requirements for architects, with tips on designing kitchens, laundry centers, outdoor kitchens, and modular workshop/storage systems for the garage using Google SketchUp and the Green Appliance Collection of 3D models. In addition, the series (episodes 20 to 24) is available at AECdaily.com, via Apple iTunes, and at School's Web site go-2-school.com.

The Future Of Appliance Design

Appliance manufacturers need to be keyed into consumer trends, through market research. As was stated in its 2004 annual report:

"Whirlpool is committed to the idea of innovation and exploration—to bring our customers the most exciting and valuable products on the market…. We will be successful only through a deep understanding of consumers' needs… Their needs, of course, anticipate the trends…."

The current trends are fairly easy to document, as we have done above with our discussion of energy efficiency, water conservation, and universal design. Other life-style issues include convenience, technology, differentiation, aesthetics, and quality of life.

Consider convenience. Speed is the key. Consumers are interested in appliances that are faster and perform with high-quality results (and ultimately use less energy and water). The convenience category also includes keeping food fresher longer and tracking groceries and supplies.

The ability to cook faster has taken a step further. Ovens feature speed cooking, an advanced version of convection

technology combined with microwave. It is considered to be four-to-six times faster than traditional convection methods.

A dishwasher drawer can be used in conjunction with the main system, or for a quick wash, by itself. A warming drawer is a great staging area when entertaining. The main dishwasher contains powerful detergent to automatically clean. And you hardly know the dishwasher is there—the noise has been abated so cleverly.

The list of recent “innovations” goes on:

• Steam ovens
• Thermal-bake ovens with convection cooking
• Smooth top induction cook tops
• Control panels that light up on command and “go dark” when not in use.

The “sensor” appliance automatically determines the size of the load of clothes or dishes that need to be washed, or the extent of spoilage, and automatically adjusts control buttons. The “intelligent” appliance will learn to recognize the user’s preferences and program the machine almost virtually by itself.

Grandma’s—and even Mom’s—kitchen has disappeared. In its place has come the concept of activity zones: a work zone, bake zone, prep zone, or clean-up zone. Each zone has its own function—and its own components. This arrangement allows for increased cooking surface and ventilation, as well as room for additional appliances. At the same time, the interest in quality and pleasing aesthetics has also been boosted.

And with the new virtual tools, like Google’s 3D warehouse and SketchUp, architects and designers will be able to respond more readily to client's needs. In that warehouse, “green” and universal product models will be spotlighted. The consumer can choose among them, and others, and immediately see the kitchen design at scale, in three dimensions…virtual reality.

It’s an exciting time. Are we at the height of technical development? What is ahead? Keep watching... UHD

The Author

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The First Optimum Performance Home™

energy generation part XII

Gary Reber

Architectural Illustration By Ronald Devesa

synopsis

A key component of the next era in new home design should be that every home needs to be self-sufficient, to the greatest extent possible, and thus should embrace clean, renewable and sustainable energy generation on-site in the form of electricity production through solar photovoltaic (solar cell) technology and wind power (where feasible).

The Optimum Performance Home will be equipped with a Day4 Energy® solar PV system, dual-stack PacWind® vertical-axis wind turbines, and GridPoint® Connect™—capable of generating enough electricity that the end result is a Zero Energy Home (ZEH) cost operation, with backup power for critical circuits in the event of a power grid failure.

Three other essential elements will be integrated into the mechanical infrastructure for the Optimum Performance Home for heating water for potable household use and radiant floor energy—TrendSetter® solar hot water system, Seisco® on-demand electric tankless water heater, and WaterFurnace® geothermal system.

Introduction

This is the twelfth article in the series documenting the design and construction of the first Optimum Performance Home™. The project has been selected by the U.S. Green Building Council (USGBC) for inclusion in the national Leadership In Energy & Environmental Design (LEED®) for Homes pilot program, their new green build certification initiative, and the goal is Platinum certification.

The home will be built at The Sea Ranch, located in Sonoma County, along the Northern California coastline of the Pacific Ocean, approximately 110 miles north of San Francisco.

The showcase project is exemplary of the "Ultimate Home Design®" concept, which integrates age-friendly universal design with the best sustainable building practices, while exerting minimal impact on the natural environment. Universal design is the inclusive, non-discriminatory design of products, buildings, environments, and urban infrastructure; as well as information technologies that are accessible to and useable by (almost) all. With respect to home design, the idea is to design and build homes that have no physical barriers, thus sustaining people of all ages and all capabilities in a functional, comfortable, and aesthetic lifestyle.

A building-science systems approach to home building is the cornerstone of the project, with emphasis on the relationship between the home's components and the envelope they create. Also paramount is good stewardship—proper regard and respect for the rights of neighboring homeowners and the

The Sea Ranch, Sonoma County, California
Photo Courtesy Rozanne Rapozo
(www.natureasiseeit.com)

surrounding natural setting, and resource efficiency. The goal is to optimize occupant health, comfort, and safety; maximize energy efficiency and structural durability; and minimize environmental impact. In addition, the aim is toward providing a nurturing home environment to support independent living and sustainable lifestyles.

Part I of this case study series appeared in Issue 1, January/February 2006. The introductory article covered the project scope. Thereafter, each issue has contained a part of the continuing series by working through site planning and preparation; Low-Impact Development (LID); further refinements to the site plan and drainage design; The Sea Ranch Design Committee-approved architectural/structural and grading/drainage submittals with conditions that translated to clarifications on certain building components and material finishes; particular aspects of the home's mechanical plan; structural aspects of foundations, structural walls incorporating Insulating Concrete Forms (ICFs) and Structural Insulated Panels (SIPs), as well as roofing; the acoustical design of the dedicated Optimum Performance Home Theatre™ and rear-projection room; interior design approaches and materials; kitchen, bath, and home fixtures; universal design architecture; and fire risk mitigation.

A Final Approval letter for The Sea Ranch Association Construction Performance Permit was issued on October 11, 2006, which is required by Sonoma County prior to obtaining a county building permit.

The necessary work to secure the building permit has been completed. Final construction plans have been approved by the Sonoma County Building Department. Six permits have been issued: site plan, landscape plan, septic system, geothermal boreholes, grading, and building. Commencement of construction with initial site grading, foundation, and mechanical infrastructure is now scheduled for early November 2007, pending no major rainstorms.

"Mortgage Meltdown" Impact

Our initial approved construction loan was lost in early August just before issuance due to the "mortgage meltdown" and a harrowing global credit crunch, which has severely impacted new construction financing. The loan company who approved the loan closed its new construction division and terminated all approved loan transactions where monies had not yet been released. With the continuing downward spiral in housing and the value of the dollar, the credit crunch for new construction, in particular, has escalated.

"Mortgage meltdown" worries surfaced in November 2006 when Investment Bank UBS reported that borrowers with sub-prime loans—the kind made to people with weak credit—were falling behind on their payments at a record pace. In the months ahead, several wholesale lenders shut down because Wall Street had cut off funding for their sub-prime loans, throwing thousands out of work. Major loan companies such as Countrywide, the nation's largest, reported in January 2007 that foreclosures the previous month had soared dramatically over the year-earlier period.

By the end of September 2007, single-family housing starts were down nearly 27 percent for the year. The September 2007 seasonally adjusted annualized pace of U.S. housing starts plunged to its lowest absolute level in over ten years, and now stands at nearly 40 percent below its peak, recorded in January of 2006.

The National Association of Realtors, a trade group that has tried to couch the slumping housing market in the best possible terms, cites the recent turbulence in the mortgage market as the reason for the dramatic downturn in home sales. Such mortgage disruptions and uncertainties, and the subsequent tightening of lending standards with tighter restrictions, are deepening the slump and now make it extremely difficult to secure a new construction loan. With the financial tumult, cash has been drained from the mortgage industry, and more than 50 lenders have gone bankrupt and a number of investment funds have collapsed. The tougher standards are affecting not only borrowers with shaky credit but also more creditworthy consumers and projects purported to be of the highest quality. Complicating matters, spooked lenders have started to shun larger deals, no matter their worthiness. Loan programs now require larger down payments, higher credit scores, and more thorough income and asset documentation. In addition, lenders are requiring more precise appraisals of properties before they approve a loan. Thus, appraisals have become extremely conservative.

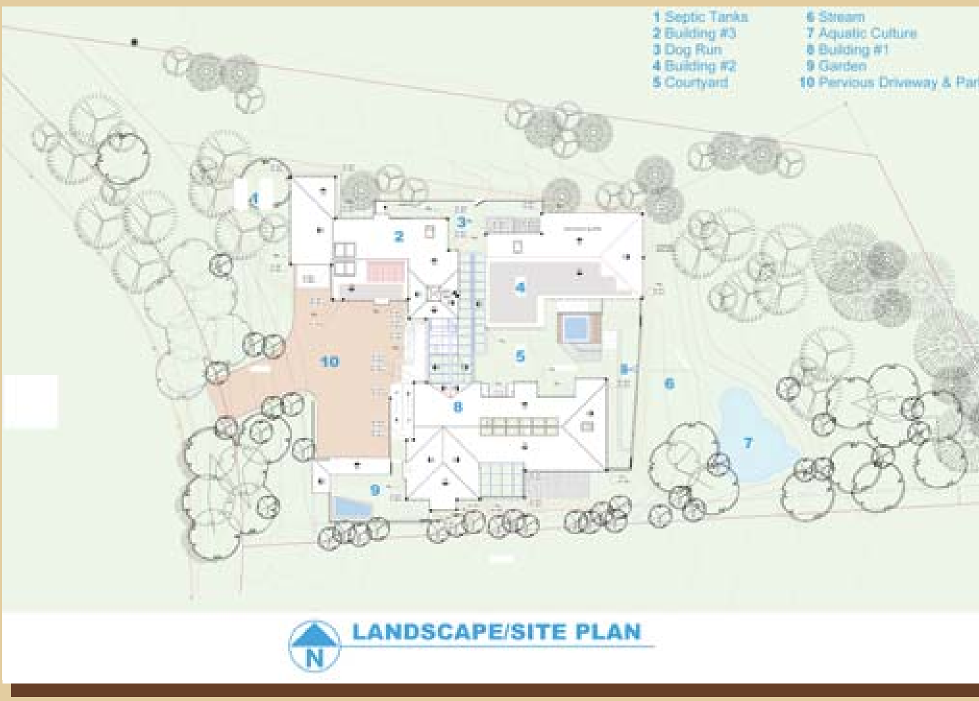
> "...homes need to be equipped with a solar PV system capable of generating enough electricity that the end result is a Zero Energy Home (ZEH) cost operation, with backup power for critical circuits in the event of a power grid failure."

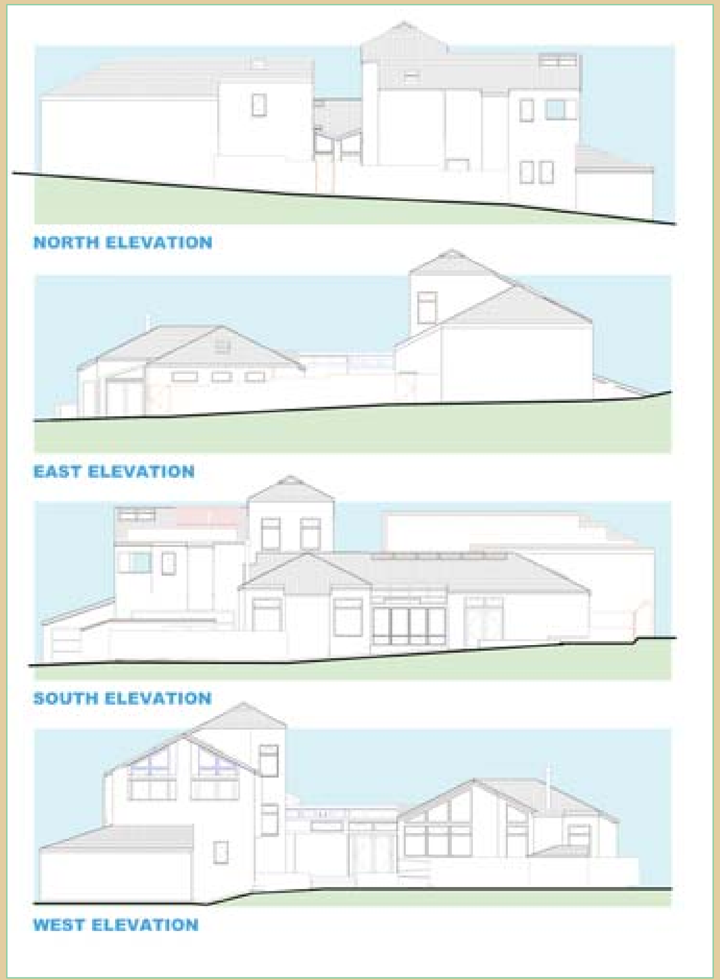
This less borrower-friendly environment has made the re-funding for constructing the first Optimum Performance Home a challenge, to say the least, even though the project meets the tougher standards and is a national showcase for "green building" and "universal design" architecture. Nevertheless, the project is moving forward with a new construction loan in place through New Resource Bank.

New Resource Bank

New Resource Bank is the nation's first "green" commercial bank. The bank, located in San Francisco, opened its doors in November 2006 after receiving final approval from the California Department of Financial Institutions and the Federal Deposit Insurance Corporation (FDIC).

As a bank that is founded by world-class entrepreneurs and green business experts, New Resource Bank is developing its green building program by drawing on leading experts within the "New Resource Community." The bank is chartered to serve the San Francisco Bay Area community. Its





The elevations of the Optimum Performance Home at The Sea Ranch

OPTIMUM PERFORMANCE HOME™ AT THE SEA RANCH, CA

chosen focus is to serve entrepreneurial community businesses and to help finance sustainable resources by funding "green" businesses and projects. The bank has specialized knowledge and networks to provide differentiated solutions to "green" and sustainable businesses and to help community businesses access options to improve their resource efficiency and sustainability. Its clients include businesses developing clean technologies, entrepreneurs specializing in ecologically friendly industries, and consumers concerned about the environment. Its staff understands the costs of doing "green" business and, therefore, can better meet their needs. As such, the bank appreciates the "ultimate home design" concepts integrated into the first Optimum Performance Home.

New Resource Bank offers financial incentives for green building projects by providing more money at a lower cost, with incentives that include lower interest rates and higher loan-to-value for projects that are designed and built to green leadership standards. The higher loan-to-value can help offset any higher initial costs to building green, however, the bank still bases its credit decision on the fundamentals of real estate lending, such as market, location, appraisal, developer/builder quality, etc.

To determine green leadership, the bank will initially rely on criteria established by the U.S. Green Building Council and its LEED certification programs but remains open to alternative approaches to demonstrate green design excellence. The bank's office on Howard Street is certified LEED Gold CI. The office incorporates extensive recycled and rapidly renewable materials, low-energy consumption lighting and HVAC, and paints and adhesives that have low VOCs (Volatile Organic Compounds) and no toxins.

As an example of its special loan offers, New Resource Bank has partnered with SunPower Corporation, a Silicon Valley-based leading manufacturer and seller of high-efficiency solar cells and panels. The bank offers financing to residential customers buying solar panels for their homes. The bank will try to match monthly loan payments to customers' electricity bill savings and spread payments over periods of up to 25 years to make the $20,000 to $40,000 installations more affordable. Customers finance their solar installation through an easy, one-step application process, and then can make monthly payments while generating their own electricity. When coupled with existing rebate programs and tax credits, the bank's attractive financing terms can bring solar energy to many more homeowners, easily and more cost effective.

This Issue

In this issue, the focus will be on the energy-generation systems for the home in terms of premium solar photovoltaic (PV) modules and vertical-axis wind power turbines and their energy management, as well as solar hot water collectors, on-demand hot water, and geothermal water heating.

Design Concept

As previously noted in this series, the home design integrates all of the concepts advocated in *Ultimate Home Design.* The goal is to demonstrate how modern building products and methods can make life safer, more comfortable, and more enjoyable. The science of optimum performance homes concerns itself with building structures that use less energy, are quieter and more comfortable, have fewer problems with material degradation, provide clean air and water, and do less damage to the environment. As an integrated and holistic design, the house will serve as a permanent residence that allows its occupants to age in place.

The high-performance building systems to be employed are designed to exceed building code requirements and resist natural disasters more effectively than a code-minimum house. Built with stronger building materials and superior techniques, the home will be safer, allowing homeowners greater peace of mind. The Optimum Performance Home qualifies for the Fortified…For Safer Living® program of the Institute for Business & Home Safety (www.ibhs.org/business_protection). This program specifies construction, design, and landscaping guidelines to increase a new home's resistance to natural disaster.

In addition, the home will meet the guidelines and qualifications for the U.S. Department of Environmental Protection's ENERGY STAR®, the EPA's (Environmental Protection Agency) WaterSense™, and the American Lung Association® Health House® programs. It also will meet the requirements of the National Association of Home Builders' (NAHB) Model Green Home Building Guidelines, the Sustainable Buildings Industry Council (SBIC) Green Building Guidelines, and the "Green Points" program. Sonoma County and The Sea Ranch Association are now considering this program for adoption.

Furthermore, the home's design will be the subject of a case study analysis presentation before the Custom Residential Architects Network (CRAN), Full Spectrum Practice Convention of the American Institute of Architects on October 20, 2007 in Chicago, Illinois.

The home is also a case study of the California Energy Commission in terms of energy-efficiency applications and an advanced water-saving plumbing plan.

Finally, the home is a national showcase for CEDIA (Custom Electronic Design and Installation Association), and is the subject of a series of articles on the design and installation of the electronic lifestyle components in the home.

The Setting

The Sea Ranch is an internationally renowned 5,000-acre environmentally protective residential development situated within a pastoral and forested coastal enclave and nature preserve approximately 110 miles north of San Francisco, California. This stunning development,

For more information on this advertiser, circle 10

now celebrating its 42nd anniversary, straddles a ten-mile stretch of Highway 1 along a stretch of uniquely beautiful rugged coastline, ending at the northern tip of Sonoma County and the south bank of the Gualala River.

The Sea Ranch is widely regarded as a unique and remarkable residential development. During the 1960s and 1970s, The Sea Ranch was at the forefront of environmentally responsible development. It was conceived and designed by architects and landscape architects who wanted to provide a harmonious mixture of custom homes and pristine natural Northern California landscape in oceanfront, meadow, and forest environments. In fact, The Sea Ranch concept and its architecture are recognized in schools of architecture around the world, and it is frequently used for case studies in environmental and architectural design. The first condominium complex to be built on the southern coastal bluffs of The Sea Ranch is now a registered national architectural site.

Single-family development occupies approximately 2,500 acres without borderline fences or other visible delineation of property lines. The remaining acres are permanent green-scape commons with 45 miles of nature trails for walkers, bicyclists, and equestrians. Each home is custom designed by an architect/architectural designer following site-specific design guidelines and is situated off a private road network without curbs, sidewalks, or streetlights. The Sea Ranch is a very unique residential development woven into a tapestry of buildings and nature and committed to environmental preservation. The development includes 2,288 lots for single-family custom homes, with 541 remaining to be developed (1,747 already developed and 29 under construction).

The Sea Ranch is managed by The Sea Ranch Association, a Common Interest Development (CID) with an elected volunteer Board of Directors, and supported by numerous volunteer committees. All development on The Sea Ranch is subject to design review and the approval of a Board-appointed autonomous Design Committee. The Design Committee is presently comprised of architects and landscape architects, though it does not include anyone with experience in vegetation management. A legal set of Covenants, Conditions, and Restrictions (CC&Rs) govern the development and are designed to protect The Sea Ranch concept.

The Home

The Sea Ranch Design Committee imposes upon designers architectural building blocks derived from the original rural structures found on the northern California coast. Designers are expected to apply their creativity to render various arrangements and deviations to arrive at a custom solution that specifically responds to the site. Successful proposals submitted to the Design Committee address the issues of passive solar positioning, wind, glazing (window) layout, privacy between neighbors, vegetation protection, view preservation, topography and grade changes, roof slopes, appropriate exterior materials and finishes, and other exterior design considerations—all within the building and site design.

A focus of the Optimum Performance Home's design is to stand as a showcase for the "green" movement and demonstrate means of reducing a home's impact on the planet through the use of Low-Impact Development (LID) and environmentally responsible building materials. It is hoped that the home will become a case study for a "Green Points Program" suited to the scale of The Sea Ranch.

The home's 3,272-square-feet living space (4,441-square-feet total building "footprint," including garages, covered walkways, courtyard, and decks) will be arranged in a three-building compound using a well-sealed, well-insulated, super-tight building envelope that reduces temperature fluctuations and enhances overall energy efficiency. This arrangement provides for an alcove courtyard protected from the prevailing wind from the northwest. The home is designed with differing spatial experiences throughout to encourage exploration. The home will display innovative interior design and be furnished in a contemporary Frank Lloyd Wright style appropriate to its dimensions. The home design connects the indoors and the outdoors with covered walkways, a courtyard, decks, and a garden to expand livable space, without requiring heating or air conditioning. The home is designed in accordance with biophilic-design principles with abundant and excellent use of natural light and natural indigenous landscaping planned. (For an in-depth analysis of the biophilic attributes of the home, please read "Biophilic Design," "Biophilic Design Attributes," and "The Interior Design Process, Part I: Synthesizing Sustainability, Universal Design, And Technology" authored by Julie Stewart-Pollack in Issue 3 (May/June 2006), Issue 4 (July/August 2006), and Issue 10 (July/August 2007), respectively.

The main-floor living area is designed to accommodate the capabilities of all occupants without any challenging physical barriers, even for the elderly and disabled. The home design features a ground-level open plan for the living room, dining room, master bedroom suite, and spacious kitchen with solarium, exhibition cooktops, and home management system.

The second building in the compound is designed to accommodate a large state-of-the-art Optimum Performance Home Theatre™ with integrated rear-screen projection room and a home office.

The third building will include a two-car and boat garage, workshop, main-level guest bathroom, and laundry room. The second level of this building will have two guest bedrooms, a bathroom, and a dedicated library/home theatre/surround music room distinguished by a high-tower feature. To insure universal access to this floor, the design provides for an Otis® Gen2 residential elevator.

The entrance and walkways that connect the three buildings and the solarium will be enclosed with insulated- and solar gain-reduced-tempered glass. There will be a seating area at the vestibule entrance to the home. The main entrance vestibule will serve as an oversized mudroom. The driveway, area around the garage, guest parking, and entrance to the home—as well as all paths—are designed in accordance with The Sea Ranch guidelines governing exterior hard-surfaced paths. All such surfaces are pervious to virtually eliminate water runoff. The surface will be packed with decorative gravel to enhance the natural appearance of the home's setting. There also will be a dedicated equipment room off the courtyard, which accommodates the Uponor® and WaterFurnace® radiant-heating apparatus, TrendSetter® solar hot water storage tanks, Microtherm's Seisco® on-demand electric tankless water heater, and other equipment. The backup Kohler® generator is housed within a separate weather-resistant tower located off the north wall of the two-car garage and guest bedroom, within the fenced dog run. This tower is designed to optimize the northwest wind performance of the PacWind® Seahawk® vertical-axis Savarrieus™ wind turbine disguised within.

The home site is nestled on an almost-acre parcel at the edge of a forested area of the southern section overlooking the Pacific Ocean, offering distant water views. Some of the home's features will include a Benissimo® slate-floor outdoor courtyard, two hardwood Ipé deck areas, in-ground Dimension One Spa® hot tub, Finnelo® Finnish sauna, and underground wine cellar. The orientation of the home on the site is designed to take advantage of natural lighting and passive solar heating and cooling. Good site and land planning will result in minimal land disturbance and preservation of natural features and environments.

Landscaping will consist of The Sea Ranch-approved indigenous vegetation with low-water requirements and unique water conservation features, including two ponds and a stream supported by rainwater catchment and captured runoff. Site grading has been specifically planned to enhance the project's placement in the watershed, and the design incorporates the principles of Low Impact Development to minimize runoff from impervious surfaces and mimic the natural hydrology in overall effect. The resultant water harvesting will then minimize the use of irrigation, and the increased infiltration and retention will passively support the native landscape. Additionally, a gray water system will be used for undersurface plant irrigation.

An "Energy Factory"

While the foundation for the extraordinary quality of life enjoyed by Americans has been our ability to generate and control large quantities of energy inexpensively, a major change looms in the future. This will be the century that America will undergo significant and fundamental changes in the way we generate and use the energy upon which our modern quality of life depends. Renewable energy sources, particularly solar energy, will play an increasingly important role in that transformation as the next decades unfold. Using solar-cell technology is the most direct method of producing useable energy from sunlight.

A key component of the next era in new home design should be that every home needs to be self-sufficient, to the greatest extent possible, and thus should embrace clean, renewable, and sustainable energy generation on-site in the form of producing its own electricity through solar photovoltaic (solar cell) technology and wind power (where feasible). To this extent, homes need to be equipped with a solar PV system capable of generating enough electricity that the end result is a Zero Energy Home (ZEH) cost operation, with backup power for critical circuits in the event of a power grid failure. The first Optimum Performance Home is designed to perform in full compliance with this requirement through the application of a Day4™ Energy high-performance premium solar PV system and a PacWind Seahawk vertical axis wind turbine system, intelligently managed by two series-connected GridPoint® Connect™ energy-management appliances.

There is no better time, at least in California, to implement an on-site energy-generation system. On January 12, 2007, the California Public Utilities Commission approved a $3.2 billion solar initiative, the largest solar program ever established in the United States. The plan is to channel 3,000 megawatts of solar power—enough to power over one million homes—into homes, businesses, schools, and public buildings. The initiative's incentives, which will apply over an 11-year period, contribute to the capital cost of solar systems that range from one kilowatt to one megawatt.

Day4 Energy Solar Photovoltaic Module System

The Optimum Performance Home will use a large high-performance premium photovoltaic module system (also called panels or receivers) developed by Day4 Energy. There are two reasons that Day4 Energy was selected:

- Patented Day4 Electrode™ technology is a radical departure from conventional PV design and manufacturing processes, offering a new and improved method of connecting to and interconnecting with crystalline silicon photovoltaic material, resulting in high electrical conductivity, exceptional power density performance, increased electrical contact redundancy, long-life durability, and cost efficiency—resulting in a significantly reduced PV cost to the end user.
- Aesthetically, the 48MC all-black-on-black 190-watt mono-crystalline silicon module is refined in appearance and stunningly attractive. The aesthetics will complement the Evergreen Welsh Black solid stone slate roof. Their appearance is a no-compromise solution, providing clean, quiet distributed solar power generation while complementing the aesthetic appearance of the Optimum Performance Home and its surroundings. Forty-six modules will be integrated into the two 27-degree slopped south-facing roofs. The uniform black-on-black appearance of the Day4 48MC modules will blend with and enhance the roof design. Solar Works, based in Sebastopol, California, will provide the installation.

Day4's proprietary technology is designed to leverage the stability as well as manufacturing infrastructure associated with the conventional PV cell production process, while addressing the inherit weaknesses of this well-established approach. Day4's proprietary Electrode technology addresses the perennial problem of connecting to photovoltaic cells, efficiently harvesting electrical current from them and interconnecting them. As a result, the resistance to the flow of electrical current from the cell is decreased by a factor greater than 10, when compared to the industry standard method, and a simpler interconnection method leads to lower manufacturing costs. The fundamental idea behind Day4's technology is to replace the widely accepted screen-printing process of the PV cell's front contact metalization with technology capable of significantly reducing the total series resistance of the PV cell.

Day4's proprietary Electrode technology, when incorporated into PV cells, can be tailored to meet the requirements of a specific power-generation application. In residential applications, Day4 PV cells have higher power output than conventionally produced alternatives. This means fewer panels are needed, meaning lower installation costs.

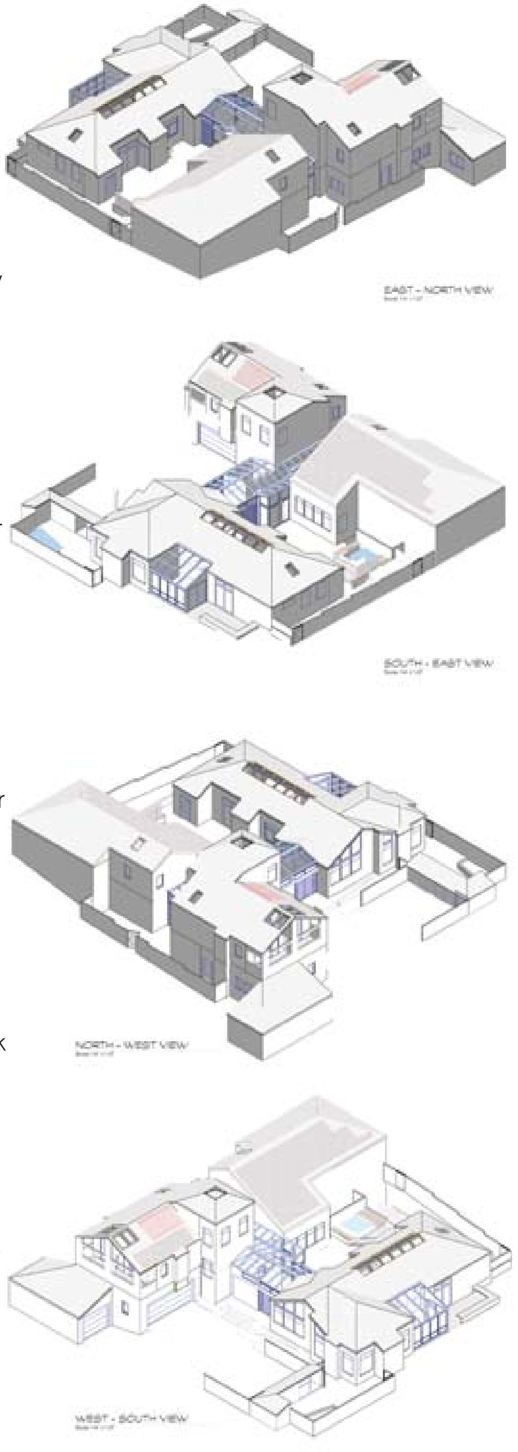
Day4's One-Sun Receiver Solar Panels can be used in a variety of both grid-connected and off-grid applications. The advanced cell interconnection means more power from less area. Because the technology

does not use ribbon bonding on the front of the panel, no energy is lost in this transfer.

Panel construction is robust and incorporates no solder-ribbon bonding on the front of the panel. The frame is made of exceptionally sturdy anodized aluminum, with extra grounding and water-draining holes for easier installation and better protection and reliability against the elements.

Day4 Energy is headquartered in the Vancouver, British Columbia area (Burnaby) of western Canada. Former Moscow State University Biophysics Professor Leonid Rubin, who is the Chief Technology Officer of the company, initially pioneered the Electrode for concentration photovoltaics in the 1990s. Day4 Energy was formed in 2001 with the mission to create solar products that will lead to price-parity with today's electrical generation technologies, without the need for subsidy programs. John MacDonald, the former aerospace pioneer and Massachusetts Institute of Technology (MIT) and University of British Columbia (UBC) professor, is the Chairman and CEO of Day4 Energy. The company has been producing the 48MC panel for the past year and introduced the black-on-black version at the Solar Power 2007 Expo in Long Beach, California, held in late September.

As an advocate for the idea of a "feed-in tariff," giving anyone who generates power from solar, wind, or hydro a guaranteed payment from the local power company, the 8.7-kW Day4 system will not only assure a net-zero cost operation with a zero power bill, but in the near future Pacific Gas & Electric (PG&E) may be required to purchase electricity produced at the home for 5.5 to 6.5 (or more) cents-per-kilowatt hour, the wholesale price of conventional power in California today. The installed system will produce an estimated 9,600 kWh annually. This is after losses from the panels, inverter, wiring, and losses due to the semi-cloudy weather in The Sea Ranch.



Four perspective views of the Optimum Performance Home at The Sea Ranch

PacWind Seahawk Wind Turbine System

The second on-site energy source of usable power is a twin-vertical-axis wind-turbine system based on new technologies created by PacWind, Inc. located in Torrance, California. PacWind's mission is to make the use of wind energy a feasible energy component of both rural and populated areas.

The Seahawk system is a proprietary turbine design that incorporates the characteristics of the Savonius design of the past, invented by S.J. Savonius in 1922. His designs are referred to as drag designs that were pushed by the force of the wind. They typically work well in lower wind conditions but have generally been lacking in energy output and never exceed a one-to-one tip-speed ratio (blade speed versus wind speed). This is due to the fact that while the wind is propelling the blades on one side of the turbine, the oncoming blades are creating resistance back into the wind. Because of this, the Savonius' decade-old designs have never been able to pack much of a punch when it comes to energy output, thus making them economically unviable in most situations.

Phil Watkins, founder and CEO of PacWind, armed with decades of experience in the wind industry, has created revolutionary turbine designs that perform admirably in the full range of wind speeds and surpass a one-to-one tip-speed ratio, without the need for either starting or braking mechanisms. His creation is a proprietary vertical-axis wind turbine (VAWT). The design incorporates characteristics of not only the Savonius' designs of the past but also the Darrieus' designs.

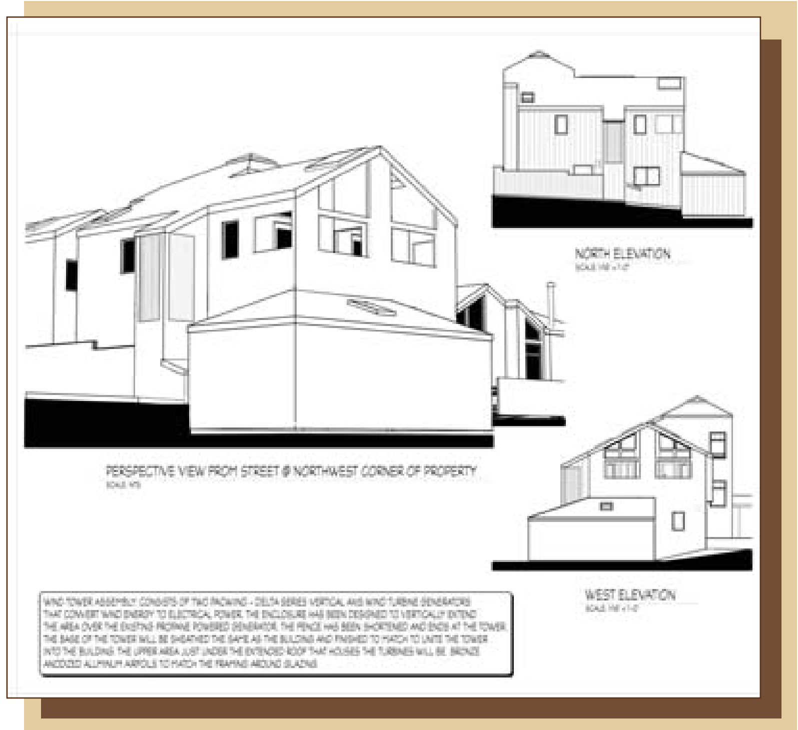
The Darrieus is a lift-producing version of the VAWT that captures the

Day4 Energy Solar PV System

• Day4 Energy's 48MC all-black-on-black 190-watt mono crystalline silicon module is both aesthetically attractive and delivers high electrical conductivity, exceptional power density performance, increased electrical contact redundancy, long durability, and cost efficiency.

PacWind® Seahawk Vertical Axis Wind Turbine

• Two vertical-axis PacWind® Seahawk wind turbines will be integrated into the home's architecture and are each power-rated at 500 watts in a 28-miles-per-hour (mph) wind, with a maximum output of approximately 1 kilowatt (kW).



power of the wind in a much different manner than Savonius' designs. These designs have no problem surpassing a one-to-one tip-speed ratio in moderate to high wind speeds, as long as they incorporated separate starting and baking mechanisms. While they are great in the fact that they can harness a great deal of the wind's energy, they are severely handicapped, in a similar fashion as horizontal axis, or propeller-based, wind turbines (HAWTs), in that they need fairly high winds to start rotating and also cannot self-regulate themselves to prevent mechanical failure from over-spinning.

The innovative PacWind Savaarrieus turbine designs are a breakthrough in that they do not require starting and breaking mechanisms as previous HAWT and Darrieus VAWT designs typically do.

The Seahawk model is designed to blend into nearly any environment. This was a critical requirement of the Design Committee at The Sea Ranch, who is particularly guarded about the aesthetics of a wind apparatus.

The Seahawk design does not require monstrous towers, as conventional HAWTs do. The reason that HAWTs must be mounted on 60- to 150-foot towers is that they require clean, or non-turbulent, air to operate effectively. If an HAWT were to be installed in a location with turbulent air, it would simply try to locate where the wind was coming from by pivoting back and forth without creating any energy, which would cause immense wear and tear on the turbine.

The Seahawk has no trouble with turbulence whatsoever, which is important for the application in the Optimum Performance Home, due to the turbulent directional airflows that occur along the Pacific Ocean coast where The Sea Ranch is located. Wind gusts of 35-miles-an-hour and greater are not uncommon at The Sea Ranch. The Seahawk doesn't care what direction the wind is coming from. Should the wind shift direction suddenly, which it generally does, the Seahawk will maintain a constant power output. There is also no wear and tear on the unit in turbulent or high winds, since it is so stable and doesn't need to pivot to find the wind direction. The unit is designed to be maintenance-free and durable, and should perform optimally over many decades.

The Seahawk can be used aesthetically nearly anywhere on a property—even attached to a home or incorporated into one, as is the case with the Optimum Performance Home. The Seahawk is compact (48 inches high x 30 inches deep) and lightweight (140 pounds), and is power-rated at 500 watts in a 28-mile-per-hour (mph) wind, with a maximum output of approximately 1 kilowatt. Two vertically stacked Seahawk turbines will be integrated into a disguised tower configuration on the north-facing side of the home's two-garage and guest bedroom structure (see architectural illustration).

For more reading see Ken Johnson's article, "PacWind: Shaping The Use Of Wind Power In Residential Architecture And Green Building," in *Ultimate Home Design* Issue 11, September/October 2007.

GridPoint® Connect™ Series Energy Management

• GridPoint® Connect™ is the first “plug-and-play” intelligent energy-management appliance to easily integrate renewable energy sources with remote-monitoring capabilities while providing clean, instant, and reliable battery backup power.

GridPoint Connect Intelligent Energy-Management System

GridPoint provides an intelligent energy-management solution that aligns the interests of consumers, electric utilities, and the environment to enable the Smart Grid.

The GridPoint Connect appliance will enhance the Day4 Energy solar PV and PacWind Seahawk Savaarrieus wind turbine renewable-energy systems by adding battery backup power, real-time monitoring, and online energy-management capabilities.

GridPoint Connect is the first “plug-and-play” intelligent energy-management appliance to easily integrate renewable energy sources with remote-monitoring capabilities while providing clean, instant, and reliable battery backup power. GridPoint Connect qualifies for federal tax credits, allowing homeowners to claim up to 30 percent of the cost of the solar system, in addition to state and local incentives.

GridPoint Connect’s standard solar/wind input capacity is 4.2 kW, but two or more Connects can add capacity for homeowners with larger energy-generation systems. In the case of the Optimum Performance Home, two GridPoint Connects will act as an intelligent hub connecting the home to its renewable energy sources, backup power, and the Pacific Gas & Electric power grid, while providing online energy-management tools to optimize electricity demands in the home.

GridPoint Connect’s battery backup feature will keep the power on when it is needed most. With 10-kilowatt hours of battery backup power and a 30-amp capacity in backup mode (double for two), GridPoint Connect will alleviate the frustrations of a power outage and power sags for critical loads. The appliance harvests energy from both residential solar arrays and wind turbines, even if the electric grid fails. Thus, homeowners can reap the benefits of increased battery longevity supplemented by the sun and wind, and enjoy hours—or even days—of clean, instant backup power.

Critical circuits in the Optimum Performance Home will be assigned to a secondary load panel—the secure load panel—to draw power from the batteries in the event of a power outage. Among the circuits to be assigned will be lights, refrigeration, kitchen appliances, heat pumps for radiant heating and hot water, home office computers, and communication systems, as well as a few easily accessible electrical outlets to power portable equipment. The duration of the actual protection is directly impacted by the homeowners’ energy consumption during an outage. Even though the backup batteries draw power only as it is needed, limiting the number of loads and using highly efficient ENERGY STAR-qualified appliances will greatly increase the duration of backup power. Through GridPoint's online energy-management portal, GridPoint Central™ homeowners can adjust energy usage during the power outage.

GridPoint Connect has a 60-amp pass-through capacity and a 30-amp capacity in “backup mode.” Therefore, in the event of a power outage, the appliance will provide up to 30 amps of backup power to the secure load sub-panel with a surge capacity of 70 amps. The maximum continuous operating power is 3.6 kVA, and the appliance has 10 kWh of battery storage—meaning it will support a 1-kW load for around ten hours (or 20 hours using two GridPoint Connects).

The system will integrate the renewable energy sources to increase battery longevity during a sustained grid failure. During a power grid outage, the Day4 Energy and PacWind renewable-energy systems connected to the GridPoint Connects will continue to provide electricity and recharge the batteries. So, in addition to the 10 kWh of stored energy in the batteries, homeowners will continue to have a steady lifeline of power equal to the amount of energy received from the renewable energy source. In the event there is no solar- or wind-power production available, the appliance will charge the batteries when grid power resumes.

The GridPoint Connect appliance, unlike fuel-based outdoor generator installations, is a clean technology designed for safe, indoor installation—combining power electronics, high-capacity battery storage, and an advanced computer system. The appliance actively communicates with the GridPoint Operations Center to ensure optimal performance, and is programmed to perform a secure data transfer to the online energy-management center and report any maintenance need to GridPoint’s customer service department. The portal is as easy to use as online banking. With a few clicks, homeowners can create a personal energy profile to automatically optimize energy usage based on consumption patterns and utility rate schedules. User-friendly, graphical interfaces empower homeowners to easily monitor energy usage (i.e., energy-usage patterns, renewable energy production, and the available energy stored in the batteries).

Through circuit-level management homeowners can learn how much energy each appliance consumes and, thus, turn loads off based on usage or on economics, and conserve energy during peak periods when electricity rates are high.

DESIGN
optimum performance home

Homeowners can access easy-to-understand environmental data based on their renewable energy production efforts (e.g., your avoided carbon dioxide emissions is equivalent to removing 100 cars from the road for a day). Homeowners can also view cost-savings information related to their participation in utility-sponsored demand response programs, enabling utilities to turn off non-essential loads to efficiently manage peak demand periods.

Homeowners can subscribe to e-mail or text-message alerts (e.g., an outage has occurred, you have ten hours of backup power available) and receive comprehensive energy reports on consumption, production, and system performance.

For more in-depth reading see Betsy Cragon’s article, “Residential Energy Management: Aligning Consumers, Utilities, And The Environment To Enable The Smart Grid,” in *Ultimate Home Design* Issue 11, September/October 2007.

Energy Systems To Generate Hot Water

There are three other essential elements to the mechanical infrastructure for the Optimum Performance Home. These elements pertain to heating water for potable household use and radiant floor energy.

TrendSetter® Solar Hot Water System

The main energy source for heating water for potable household use will be provided by TrendSetter® Industries, Inc., using two proprietary solar collectors on the southern roof above the guest bedroom. Each of the black solar collector arrays is made of 30 non-combustible borosilicate impact-resistant evacuated glass tubes with a copper super-heat pipe and aluminum heat fin within each tube. The evacuated tubes are tied together with a single 30-tube header. The header consists of a fiberglass-insulated copper manifold contained within a black powder-coated aluminum casing, which is mounted to the roof as a complete evacuated tube array with a stainless-steel frame.

A 200-gallon TS-200 TrendSetter Solar Thermal Storage Tank will supply preheated water. The weather-resilient tank will be located in the courtyard equipment room. All TrendSetter solar tanks

TrendSetter® Industries’ Evacuated Solar Tube Collectors

• TrendSetter® solar-tube systems reduce the water-heating portion of a utility bill by as much as 90 percent. Each of the solar collector arrays are made of 30 non-combustible borosilicate impact-resistant evacuated glass tubes with a copper super-heat pipe and aluminum heat fin within each tube.

Seisco® RA-28 On-Demand Electric Tankless Water Heater

• The Seisco® RA-28 is designed for whole-house replacement of storage tank water heaters or backup applications using solar and geothermal passive heat-recovery systems where the inlet water temperatures are above 65 degrees Fahrenheit.

feature a drain-back design, with internal copper heat exchangers installed. They are extremely robust and dependable, and will remain maintenance free for decades.

The concept of solar water heating is to heat the water before it enters the gas-fired water heater, whether it is a tank or tankless water heater. Most water heaters use either natural gas or liquid propane as the source heat. It costs three times less to solar preheat electric water heaters than it would using natural gas or propane. There is a $2,000 Federal Government tax credit for the purchaser of a new solar system approved by the Solar Rating Certification Corporation.

For more reading, see Norm Ehrlich’s article, “Solar Water Heating...A Sure Bet,” in *Ultimate Home Design* Issue 5, September/October 2006 and “Pushing The Envelope With The TrendSetter PiggyBack™ Solar Water Heating System,” in Issue 11, September/October 2007.

Seisco® On-Demand Electric Tankless Water Heater

A Microtherm Seisco® on-demand electric tankless water heater will serve as the perfect backup to the TrendSetter solar water heating system, should that system not achieve the desired hot water temperature at any given moment. The Seisco was introduced to the market after 14 years of research and testing. The technology has earned its developer, David Seitz, five separate U.S. and many additional foreign patents, and is recognized as a STANDARD for all tankless water

WaterFurnace® Geothermal System

• The efficiency ratings of a geothermal system are up to five times higher than conventional heating and cooling systems. WaterFurnace® leads the industry with its ENERGY STAR®-qualified Envision Series, the first to achieve 500 percent efficiency in heating.

heaters by providing the highest level of temperature-control performance, reliability, and safety in its operation over any tankless water heater anywhere in the world today.

The Seisco was chosen for HUD's (the U.S. Department of Housing and Urban Development) first ever "PATH Concept Home." Standard off-the-shelf heating elements and no moving parts or flow-restricting devices are used in Seisco heaters. Seisco uses a unique flow/no-flow detection system utilizing its temperature sensors for flow detection. In standby, the heater maintains a very subtle temperature gradient, and flow is detected when there is a change in the gradient. The advanced microprocessor control turns the power on through a set of relays and turns the power off when flow stops. An important feature is the patented "Power Sharing" technology, which provides for evenly distributed power to the heating elements. This, in turn, helps eliminate scalding potential, scaling, and sediment buildup. Also, the control logic allows the power level to vary, which is beneficial in minimizing the use of power for periods of less demanding usage.

The Seisco RA-28 is designed for whole-house replacement of storage tank water heaters or backup applications, using solar and geothermal passive heat-recovery systems, where the inlet water temperatures are above 65 degrees Fahrenheit. The RA-28 will provide endless hot water in combination with the TrendSetter solar collectors and Solar Thermal Storage Tank and WaterFurnace® geothermal system. The Seisco will only be activated after the water temperature drops below a predetermined set point, say 115-degrees Fahrenheit, then heating ONLY the water actually used, and only for the temperature difference required. The Seisco will not only improve the overall efficiency and cost effectiveness of the passive systems, it will insure an endless and continuous supply of hot water, whether the passive systems are providing heat or not. The four-chamber model contains four electric heating elements whose combined wattage is the total power rating of the heater. The RA-28 model is equipped with four 7,000-watt elements, for a total of 28,000 watts, or 28 kilowatts (kW) of power.

WaterFurnace® Geothermal Energy System

A geothermal system utilizes the Earth as a free heat source. While outdoor air temperatures fluctuate from season to season, ground temperatures stay consistent all year long. The ground is able to maintain a higher rate of temperature consistency because it absorbs 47 percent of the sun's energy that reaches the Earth's surface. During the heating cycle, a geothermal system regularly circulates water through its ground loop to extract heat. The unit then transfers this heat from the loop to the home in the form of forced air distributed through a conventional duct system (heating or air conditioning), hot water for radiant floors, and domestic hot water heating.

For the Optimum Performance Home, a geoexchange system manufactured by WaterFurnace International, Inc. has been chosen as the means for heating and air conditioning. The system (also commonly referred to as a ground-source heat-pump system or geothermal heat-pump system) consists of three main components—the heat pump, which is the foundation of the system (manufactured by WaterFurnace); a closed-loop vertical "well" system, which is drilled into the constant temperature Earth on site; and water, which is circulated between the ground loop and the heat pump in high-density polyethylene pipe. The ground-loop portion of the geoexchange system uses the constant temperature of the Earth as a heat source instead of natural gas or propane for increasing the efficiency of an electric ground-coupled heat pump. A heat pump can provide both heating and cooling, and it operates on the same type of refrigeration cycles as conventional HVAC equipment. The difference is that the ground-coupled heat pump can take 1 kW of electricity and turn it into 3 or 4 kW of heating energy for the home.

On the Optimum Performance Home project, the water-to-water ground-coupled heat pump will be making hot water to be distributed through the home in a radiant floor distribution system manufactured by Uponor®. All of the rooms in the home will have radiant floor heating. In addition, the Optimum Performance Home Theatre™ and rear-projection room will be cooled with a two-zone water-to-air ground-coupled heat pump. This type of system was selected for the home theatre and projection room because it is expected that more continuous cooling will be required to offset the heat created by the projection and audio equipment. These heat pumps will be connected to a single ground-loop system that will allow the heat pumps to operate in heating and cooling modes simultaneously.

The system will consist of five vertical boreholes drilled 310 feet down into the Earth by Weeks Drilling & Pump Company, based in Sebastopol, California. The boreholes will be located under the guest parking area at the front of the home. WaterFurnace Envision heat pumps are specified. The units utilize ozone-safe R-410A refrigerant to meet the most stringent Environmental Protection Agency (EPA) requirements.

The efficiency ratings of a geothermal system are up to five times higher than conventional heating and cooling systems. WaterFurnace leads the industry with its ENERGY STAR-qualified Envision Series, the first to achieve 500 percent efficiency in heating and an impressive 30 EER (Energy Efficiency Rating) in cooling as rated by the Air Conditioning and Refrigeration Institute in category 13256-1 (GLHP).

WaterFurnace systems utilize ultra-quiet Copeland Scroll™ UltraTech™ compressors, extra insulation buffers, and acoustic metals to provide the quietest heating and cooling system on the planet.

Geothermal systems are great for the environment because they burn no fossil fuels while operating. The EPA (Environmental Protection Agency) stated that installing a geothermal system in a typical home is equal to planting an acre of trees or taking two cars off the road in greenhouse gas reduction. The average geothermal system reduces carbon emissions by over 50 tons during its operational life span. In addition, current geothermal installations save more than 14 million barrels of crude oil per year. If one in 12 California homes installed a geothermal system, the energy saved would equal the output of nine new power plants.

Federal tax credits are available for geothermal systems. These can be viewed on the ENERGY STAR Web site at www.energystar.gov/index.cfm?c=products.pr_tax_credits.

For more reading, see Lisa Meline's article, "The Mechanical Engineer's Role," in *Ultimate Home Design* Issue 5, September/October 2006 and Ryan Stauffer's article, "Geothermal Systems Save Homeowners Money And Protect The Environment" in Issue 11, September/October 2007.

Next

Now that all of the necessary Sonoma County Building Department permits have been issued and our new construction loan is secured, this continuing series of articles will focus on the design elements as they pertain to each stage of construction, and will include coverage of the technologies and building systems and the materials used and applied to construct the first Optimum Performance Home. **UHD**

The Author

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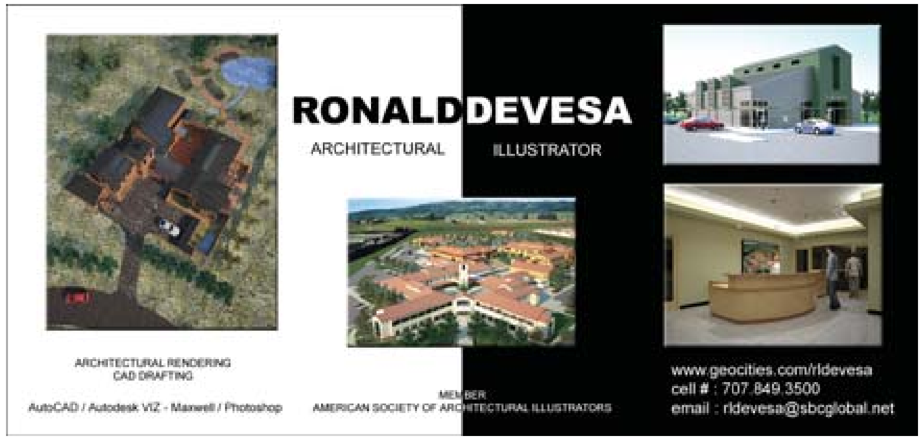
Product Information

- Day4 Energy, Inc., #101-5898 Trapp Avenue, Burnaby, British Columbia Canada, V3N 5G4, 604 759 3294, www.day4energy.com
- GridPoint, 2020 K Street, NW, Suite 550, Washington DC, 20006, 888 998 GRID (4743), www.gridpoint.com
- Microtherm Inc., 223 Airtex, Houston, Texas, 888 296 9293, www.seisco.com
- New Resource Bank, 405 Howard Street, Suite 110, San Francisco, California 94105, 415 994 8100, www.newresource-bank.com
- PacWind, Inc., 23930 Madison Street, Torrance, California 90505, 310 375 9952, www.pacwind.net
- SolarWorks, 4925 Gravenstein Highway North, Sebastopol, California 95472, 707 829 2518, www.solarworksca.com
- TrendSetter Industries, Inc., 818 Broadway, Eureka, California 95501, 800 492 9276, www.trendsetterindustries.com
- Uponor North America, 5925 148th Street West, Apple Valley, Minnesota 55124, 952 997 5329, www.uponor-usa.com
- WaterFurnace International, Inc., 9000 Conservation Way, Fort Wayne, Indiana 46809, 800 222 5667, www.waterfurnace.com
- Weeks Drilling & Pump Company, 6100 Highway 12, Sebastotol, California 95472, 707 823 3184, www.weeksdrilling.com



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Save With ENERGY STAR

Jill Abelson

synopsis

- Americans saved enough energy in 2006 alone, with the help of ENERGY STAR, to avoid greenhouse gas emissions equivalent to those from 25 million cars—all while saving $14 billion on their energy bills.
- Compared to mandatory minimum performance standards, ENERGY STAR specifications, or energy performance criteria, are voluntary in nature, meaning manufacturers are not required by control standards/regulations to build any products that meet ENERGY STAR specifications.
- The ENERGY STAR program highlights that there are two real product price tags: 1) the initial cost of the product at the time of consumer purchase, and 2) the cost of energy to operate the product over its lifetime.

With rising energy prices and growing nationwide concern about global warming, energy efficiency has become a household concern. Today, 98 percent of consumers agree or strongly agree that "it is important to save energy in one's home" and almost 95 percent of consumers agree or strongly agree that "saving energy helps the environment." The ENERGY STAR® program, a jointly sponsored program by the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA), is helping address those concerns.

A primary goal of the ENERGY STAR program is to prevent global warming caused by the inefficient use of energy. The EPA and DOE use the ENERGY STAR mark to recognize and promote the most energy-efficient products within a given category available to consumers. This easily recognizable symbol allows consumers to easily identify environmental and money saving products in the marketplace. Over the years, the ENERGY STAR program has stimulated a demand for high-efficiency products and, in doing so, has worked to transform the market.

The ENERGY STAR program was introduced by the EPA in 1992 as a voluntary initiative designed to help categorize and promote energy-efficient products and in 1996, the EPA partnered with the DOE to expand the program into several new product categories. Now, 15 years later, it has since become a household name, recognizable by over 65 percent of consumers nationwide and a trusted label to more than 50 product categories, such as office equipment, home electronics,

heating and cooling equipment, and lighting fixtures. Beyond products, the ENERGY STAR program has also expanded to cover new homes and industrial and commercial buildings.

Not only has the ENERGY STAR program expanded since its inception, but it consistently delivers on its mission of helping consumers save money, and protecting the environment as well. Americans saved enough energy in 2006 alone, with the help of ENERGY STAR, to avoid greenhouse gas emissions equivalent to those from 25 million cars—all while saving $14 billion on their energy bills. On a more micro level, the typical household spends more than $1,900 a year on energy bills. With ENERGY STAR, consumers can save over 30 percent, or about $600, annually.

As the ENERGY STAR program continues to grow, there are specific criteria that must be taken into account when considering whether a new product category is suitable for development of an ENERGY STAR specification. This new product category must be consistent with the general ENERGY STAR philosophy, as well as reflect the unique facets of that particular new product or industry.

Overview Of The ENERGY STAR Specification Development Process

Compared to mandatory minimum performance standards, ENERGY STAR specifications, or energy performance criteria, are voluntary in nature, meaning manufacturers are not required by control standards/regulations to build any products that meet ENERGY STAR specifications. Rather, product manufacturers are able to use the ENERGY STAR mark voluntarily once they sign a Partnership Agreement to join the program, given two conditions are met. First, the product must logically fit into an established product category for which an

> A primary goal of the ENERGY STAR program is to prevent global warming caused by the inefficient use of energy.

ENERGY STAR specification exists; second, the product's measured performance must meet or exceed all of the requirements found in the appropriate ENERGY STAR product specification.

As the ENERGY STAR program has expanded from one product category to over 50 categories, the EPA and the DOE have, over time, developed a systematic framework to (1) assess the feasibility for applying the label to a product category; (2) develop performance specifications that must be met in order to earn the label; and, (3) reassess performance specifications as market conditions change. To ensure that the ENERGY STAR mark remains an effective consumer tool, the EPA and DOE strive to ensure that the resulting performance-based specifications identify energy-efficient products that when used result in reasonable financial return without sacrificing product performance or features.

When deciding if a specific product category could feasibly qualify for development of a new ENERGY STAR specification, the EPA and DOE follow a set of six key guiding principles. These underlying principles rely not only on rigorous market, engineering, and pollution savings analysis but also on input from industry and other stakeholders. They are as follows:

1. Significant energy savings can be realized on a national basis.

The EPA and DOE seek to identify product categories that can contribute significant energy savings nationwide. An ENERGY STAR specification can achieve sizable energy savings from a product category where there are significant savings on a unit basis and relatively small annual unit sales, or where there are relatively small energy savings on a unit basis but very large annual unit sales.

2. Product performance can be maintained or enhanced with increased energy efficiency.

The EPA and DOE seek to maintain the ENERGY STAR label as an attractive purchasing tool for a broad array of consumers. This is accomplished by ensuring that the label is not only a credible symbol for energy efficiency, but that it is also found on products with the features and performance that consumers demand. It should be clear that ENERGY STAR products do not substitute energy efficiency for performance or safety.

3. Purchasers will recover their investment in increased energy efficiency within a reasonable period of time.

The ENERGY STAR program highlights that there are two real product price tags: 1) the initial cost of the product at the time of consumer purchase, and 2) the cost of energy to operate the product over its lifetime. ENERGY STAR specifications are set so that if there is a cost differential at time of purchase, that cost is recovered through utility bill savings over a reasonable period of time for the typical consumer.

4. Energy efficiency can be achieved with several technological options, at least one of which is non-proprietary.

The EPA and DOE are careful not to favor one manufacturer over others by designating a proprietary technology or unique design approach when developing the performance attributes of an ENERGY STAR product specification. Along these lines, the specification should be set so that more than one manufacturer can meet it with at least one of their product models.

5. Product energy consumption and performance can be measured and verified with testing.

ENERGY efficiency

Figure 1: Specification Development Cycle

Product testing has two roles: 1) to yield accurate energy-consumption values for products whose manufacturers are hoping to earn the label, and 2) to verify that labeled products are performing at the appropriate levels and delivering on ENERGY STAR's promise to consumers. To this end, the EPA and DOE make every effort to choose energy performance metrics for which an industry accepted test procedure exists and is in use by manufacturers.

6. Labeling would effectively differentiate products and be visible for purchasers.

The EPA and DOE set specifications that can be met by only the most efficient products within the category. This level typically represents approximately the top quartile of products currently available in the market at the time the specification is initially set. By recognizing the top quartile, the EPA and DOE distinguish these products from others and, thereby, add to their intrinsic value.

If the product category fits these overarching guiding principles, then the Product Development team at the EPA and DOE begins the specification development process. This process also has an overriding framework and specific guidelines, called the Specification Development Cycle, illustrated by Figure 1.

Lighting

The average home has approximately 30 light fixtures, and lighting represents a sizeable and growing portion of household electricity load. The technology most commonly used in residential lighting today is incandescent, based on a late nineteenth century invention (Thomas Edison's incandescent light bulb) that relies mainly on using electricity to heat up a filament. The heated filament radiates such that it emits visible light. Of the energy that is used to create visible light in this incandescent process, only eight percent actually produces visible light, while the rest is lost in generating heat and infrared radiation. Thus, the incandescent lamp (light bulb) is a very inefficient source in using power to create light. Moreover, many of the ways lighting is used in applications are inherently wasteful of energy because of poor fixture design, wasteful operation cycles, and poor lighting fixture layouts. The solutions to all of these issues are available today, and ENERGY STAR is helping to drive the lighting market to adopt lighting practices that successfully address each of these issues.

Fluorescent lighting sources are a much more efficient way of producing light than traditional incandescents. Per each one watt of power, fluorescent lighting produces over 45 lumens of light, making it one of the most efficient light sources available. In fact, a single fluorescent lamp uses 75 percent less energy than standard incandescent lamps. Moreover, fluorescent lamps last ten times as long as traditional incandescent. As they are inexpensive high-efficiency sources that can save a significant amount of power usage, many of today's ENERGY STAR-qualified lighting fixtures use fluorescent technology.

While fluorescent lighting in its inception was largely based on linear glass tubes that emitted a harsh blue/green color of light and contained heavy ballasts that buzzed and made the lights flicker when they were turned on, today's fluorescent technology is much improved. In fact, fluorescent sources can now have the soft pleasing color of incandescent lamps,

instant-on illumination, quiet operation, and dimmability. New shapes of compact fluorescent lamps (CFL) feature spiral and round configurations, which allow the CFLs to be placed in small fixtures where incandescent lamps would normally go. Most anywhere an incandescent lamp can be placed in a home, a CFL can be used to produce the same quality of light with less wattage. With the advent of smaller and more decorative fluorescent lamps, ENERGY STAR lighting fixtures are being designed that have the same appearance as traditional incandescent fixtures.

Lighting fixtures qualifying for ENERGY STAR must be manufactured in a way that the energy-savings benefits of the product are permanent. The fixture cannot contain a screw-base socket that would potentially allow a future replacement incandescent lamp to be installed. Rather, the CFLs used in ENERGY STAR-qualified lighting fixtures must contain a "pin-base" configuration that only allows another efficient source to be installed into that fixture as a replacement. Up until now, most of these pin-base designs required a separate remote ballast to be installed in the fixture, and the lamp was then installed into the socket. Now, the newest CFL lamp base is a "GU-24" pin configuration that actually allows the integration of the lamp and ballast as one unit.

These new GU-24 style lamps are much easier for customers, as they allow simple replacement and a variety of lamp wattages to be installed in an ENERGY STAR-qualified fixture. However, most ENERGY STAR fixtures are also required to include a CFL lamp in the fixtures that lasts at least 10,000 hours. Thus, it should take years before a customer needs to worry about replacement lamps.

The newest technology on the horizon for energy efficiency is Solid-State Lighting. Solid-State Lighting (SSL) fixtures use tiny Light Emitting Diode (LED) sources for generation of light. LED sources radiate very little heat, last approximately five times longer than fluorescent, and have the potential to be the most efficient lighting sources available. LED sources already have surpassed incandescent efficiency and are now approaching the efficiency levels of fluorescent. While ENERGY STAR SSL fixtures are not yet available in the market, the program is now developing specifications for this technology to be available in 2008.

Electronics

Since the launch of the first ENERGY STAR product specification in 1992 for computers and monitors, the ENERGY STAR suite of electronics products has grown to encompass a wide range of consumer electronics and office equipment products, and the list continues to expand. Specifications currently exist for audio and DVD equipment, cordless telephony products, digital-to-analog TV adapters, televisions, battery-charging systems, imaging equipment, computers, and video monitors. And through the launch of the ENERGY STAR specification for external power supplies in 2005—the ubiquitous little black box used to power a range of small electronics products—consumers are now able to purchase a variety of devices that are packaged with qualified power supplies, such as cell phones and digital cameras.

In April and July 2007, respectively, newly revised and strengthened specifications took effect for imaging equipment and computers. For the first time, these specifications now include requirements to reduce power consumption when these products are actually on, leading to increased savings for the consumer. (Older specifications only addressed standby power, so the energy was used when the product was "off.") A typical home office equipped with a fax, copier, and scanner that meets the new ENERGY STAR requirement is projected to save more than $115 over the life of the products.

Electronics product categories currently under development include televisions and set-top boxes. Existing ENERGY STAR television specification, in effect since 2002, focuses only on standby—so the energy is used by the product when it is plugged in, but not on. The EPA is working with its stakeholders to revise the specification to include both on and standby mode requirements, leading to increased savings for the consumer. The specification will be technology-neutral, meaning that all TVs, irrespective of screen type, will have to meet the same requirements to earn the ENERGY STAR. The proposed effective date for these new requirements is September 1, 2008.

The ENERGY STAR specification for set-top boxes, currently under development, covers devices such as cable boxes, digital TV adapters (required to convert new digital broadcast signals to analog signals for analog TV sets), and digital video recorders (DVRs). The proposed specifications include requirements both for box manufacturers and service providers, recognizing that both have a critical role to play in reducing the amount of energy these products consume. Today's TVs and HDTVs, when combined with related products like DVD, HD DVD, and Blu-ray Disc players and set-top boxes, make up about ten percent of a household's annual electricity bill. With the development of new specifications to address "on" mode power consumption for these products, the EPA believes that ENERGY STAR will play a vital role in helping consumers make informed, energy-efficient purchasing decisions, while not sacrificing product performance and quality.

Home Appliances

The ENERGY STAR home appliances product category encompasses many of the most frequently used household appliances—clothes washers, dishwashers, freezers,

refrigerators, and room air conditioners. ENERGY STAR-qualified appliances can save homeowners on both energy costs (~ $75 a year) and water. ENERGY STAR offers a range of energy-saving advice for appliances and other products on its interactive Web-tool, called ENERGY STAR@Home (link to tool from www.energystar.gov).

Currently in development are new and/or revised specifications for water heaters, ventilation fans, non-ducted A/C units (also known as mini-splits), and water coolers. The EPA is collaborating with international partners toward initial scoping for other new products, for example, microwaves.

HVAC

ENERGY STAR currently qualifies seven heating, ventilation, and air-conditioning (HVAC) products: air-source heat pumps, boilers, central air conditioners, furnaces, geothermal heat pumps, light commercial HVAC equipment, and programmable thermostats. ENERGY STAR-qualified HVAC products provide the same amount of comfort year round, while saving you energy and money on your utility bills.

ENERGY STAR-qualified HVAC products are as much as 30 percent more energy efficient than standard models. And when used in conjunction with ENERGY STAR home sealing (insulation and air sealing) and duct sealing, you will get increased heating and cooling performance in addition to energy and money savings. ENERGY STAR-qualified oil and gas furnaces have 83 percent and 90 percent annual fuel-utilization efficiency (AFUE) ratings. AFUE represents the ability of the furnace to convert fuel to energy. The higher the AFUE, the more efficient the furnace is at delivering heat energy into your home. Starting October 1, 2008, these minimum requirements will increase to 85 percent and 92 percent AFUE, respectively.

ENERGY STAR-qualified boilers have AFUE ratings of 85 percent or greater and are 13 percent more efficient than standard models. ENERGY STAR-qualified air-source heat pumps and central ACs have a higher seasonal energy efficiency rating (SEER) and energy efficiency ratio (EER) than standard models—14 SEER or greater and 11 EER or greater (11.5 EER for split systems)—and are eight percent more efficient, on average. SEER represents the ratio of the cooling output divided by the power consumption during the normal cooling season. EER is an instantaneous measure of the energy efficiency of cooling equipment. A higher SEER and EER mean increased efficiency. ENERGY STAR-qualified air-source heat pumps must also have a heating seasonal performance factor (HSPF) of 8.0 or greater (8.2 for split systems). HSPF is the measure of a heat pump's energy efficiency over one heating season.

In addition to individual energy and dollar savings, there are environmental benefits to installing ENERGY STAR-qualified HVAC products in your home. If just one household in ten purchases ENERGY STAR heating and cooling equipment, the change would keep 17 billion pounds of carbon dioxide out of our air, the equivalent to the annual emissions of almost 1.5 million cars.

What's Next?

Over the next year, the EPA and DOE plan to further expand the ENERGY STAR program. In the residential sector, an ENERGY STAR specification for water heaters, currently under development, is expected to be finalized and become effective in late 2008. The EPA will begin work to develop new Tier II specifications for imaging equipment and computers, and also begin conducting research into the potential energy-saving benefits of smart meters.

Home networking is another area of interest for the EPA. With the advent of "always on, always connected" products, electronics are becoming an ever-increasing portion of a household's annual energy bills. In 2006, according to the DOE's Energy Information Administration, electronic products accounted for about 14 percent of total residential electricity consumption. By 2020, it's projected that electronics will account for about 19 percent of total residential electricity consumption—more than any other major end-use category, i.e., lighting, heating, cooling, water heating, and appliances. By conducting research into networking, which may ultimately lead to working with stakeholders to develop ways in which networked products can communicate with each other more efficiently, the EPA is working to address the growing energy consumption attributed to electronics products.

For more information, visit the ENERGY STAR Web site at www.energystar.gov. UHD

The Author

Jill Abelson is a Communications Manager for the Environmental Protection Agency's ENERGY STAR Program. She oversees national outreach aimed at transforming the market toward energy efficiency in multiple product categories, and has played a key role in product launches, marketing, branding/communications, and industry partnerships. She can be reached at abelson.jill@epa.gov.

The Energy-Efficient Kitchen

Richard H. Karney

synopsis

- According to the United States Department of Energy (DOE), each year the American average household spends about $1,900 on home energy bills, and inefficient household appliances are major contributors to those costs.
- In the kitchen, there are a number of energy-efficient upgrades and small behavioral changes consumers can make that will save money and contribute to improving the environment—one home at a time.
- Some refrigerators may seem like they work fine, but the truth is, any refrigerator manufactured before 1993 should be "retired" and replaced with a new energy-efficient model.
- Compact fluorescent light bulbs (CFLs) use 75 percent less energy than a traditional incandescent bulb and can be used in a regular light socket without sacrificing any light output.

Homeowners across the country unwittingly throw money away every time they do a load of laundry, open their refrigerator, or run their air conditioner or dishwasher.

Each time you run an inefficient dishwasher, your money gets sucked down the drain along with unnecessary gallons of water.

Whenever you grab a can of soda or a glass of milk from an energy-guzzling refrigerator, the cost to keep these drinks chilled may far outweigh what you paid for them at the grocery store.

And every time you turn on an incandescent light bulb in your kitchen, or any other room in your house, you're not only burning a hole in your wallet, you're also increasing air pollution and greenhouse gas emissions.

According to the United States Department of Energy (DOE), each year the American average household spends about $1,900 on home energy bills, and inefficient household appliances are major contributors to those costs.

Clothes washers, refrigerators, dishwashers, and even small ticket items, like light bulbs, can all be upgraded to cost-effective, energy-efficient models. The DOE sets standards for certain products to meet ENERGY STAR® qualifications. American consumers who use ENERGY STAR-qualified products can save up to 30 percent on their utility bills, or more than $600 per year. Consumers who opt for these energy-efficient choices can save not only on their monthly energy bills, but also make a significant dent in greenhouse gas emissions.

There are more than 50 categories of products that can qualify for the ENERGY STAR label. In the kitchen alone, there

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are a number of energy-efficient upgrades and small behavioral changes consumers can make that will save money and contribute to improving the environment—one home at a time.

People who still wash dishes by hand are wasting more than just their valuable time hunched over their kitchen sinks. Getting in the habit of using an ENERGY STAR-qualified dishwasher instead of doing dishes by hand can cut utility bills by more than $40 per year. Additionally, upgrading to an ENERGY STAR-qualified model can save 40 to 75 percent per year on energy and water bills (depending on gas water heating or electric water heating).

Of course, not everything in life is measured in money. Who couldn't use an extra ten days of free time during the year? That's precisely the amount of time—230 hours—each person can save by choosing to use an energy-efficient dishwasher, instead of putting on an apron and grabbing the dishrag and then scraping and scrubbing dishes by hand. This means, instead of wasting time scrubbing and rinsing dishes and utensils after every meal, all a person has to do is load the dishwasher and press start—maybe relax and read a book, surf the net, or take in a movie with the newfound spare time—now that the job is done.

ENERGY STAR-qualified dishwashers use less than half as much energy as washing dishes by hand and save nearly 5,000 gallons of water per year. And, these models reduce air pollution and greenhouse gases caused by burning fossil fuels.

Dishwasher energy efficiency is measured by Energy Factor (EF), which includes machine electrical energy and energy used to heat the water. It is expressed in cycles per kilowatt hour (kWh), and the higher the EF, the more efficient the dishwasher. The new ENERGY STAR criteria for dishwashers took effect on January 1, 2007. To meet it, models must be at least 41 percent more energy efficient than the minimum federal standard.

The federal standard for standard dishwashers (greater than or equal to eight place settings and six serving pieces) is an EF greater than or equal to .46. The ENERGY STAR criterion is an EF of greater than or equal to .65.

For compact models (less than or equal to eight place settings and six serving pieces), the federal standard is an EF greater than or equal to .62, with the ENERGY STAR criteria set at greater than or equal to .88.

Another kitchen upgrade to consider is the purchase of a new refrigerator. Some refrigerators may seem like they work fine, but the truth is, any refrigerator manufactured before 1993 should be "retired" and replaced with a new energy-efficient model. While this may seem financially painful or unnecessary to some consumers, it makes financial sense in the long run.

A new ENERGY STAR-qualified refrigerator uses less than half the energy of one made prior to 1993. Similar to the benefits of a dishwasher, an ENERGY STAR-qualified refrigerator uses less energy, and thereby, helps to reduce air pollution and greenhouse gases.

Consumers will even see an increase in the length of time their food stays fresh. Advanced temperature controls and specialized compartments help keep perishable foods cold, so they stay fresh longer.

BUYING A NEW ENERGY STAR DISHWASHER INSTEAD OF A REGULAR DISHWASHER

	GAS WATER HEATING			ELECTRIC WATER HEATING		
	ENERGY STAR DISHWASHER	NON-QUALIFIED	SAVINGS	ENERGY STAR DISHWASHER	NON-QUALIFIED	SAVINGS
ENERGY USE (therms/year)	6.5	9	2.5	N/A	N/A	N/A
ENERGY USE (kWh/year)	135	158	23	307	358	41
WATER USE (gallons/year)	860	1,290	430	860	1,290	430
ENERGY AND WATER BILL ($/year)	$27	$35	$8	$35	$42	$7

SWITCHING FROM HAND WASHING TO AN ENERGY STAR DISHWASHER[1]

	GAS WATER HEATING			ELECTRIC WATER HEATING		
	ENERGY STAR DISHWASHER	HAND WASHING	SAVINGS	ENERGY STAR DISHWASHER	HAND WASHING	SAVINGS
ENERGY USE (therms/year)	6.5	28	21	N/A	N/A	N/A
ENERGY USE (kWh/year)	135	N/A	-135[2]	307	539	232
WATER USE (gallons/year)	860	5,805	4,945	860	5,805	4,945
ENERGY AND WATER BILL ($/year)[3]	$27	$67	$40	$35	$81	$46

[1] Average household savings.

[2] For homes with gas water heating, installing a dishwasher will lead to an increase in electricity consumption (to operate the dishwasher) and a decrease in gas consumption (from reduced hot water needs). The net effect is a reduction in both total energy use (Btu) and total utility bills.

[3] Utility rates used to estimate dollar amounts are as follows: 10.19¢/kWh, $1.46/therm (Source: U.S. Department of Energy, 2006) and $0.004529/gallon (Source: Raftelis Water and Wastewater Rate Survey, 2004).

And, while retiring an older perfectly working refrigerator and replacing it with a new ENERGY STAR-qualified model may seem wasteful, the real waste would be to continue to use the inefficient unit. The monthly utility bills will prove it makes financial sense in the long run, as an ENERGY STAR-qualified refrigerator will save over $55 per year on energy bills. Plus, since the typical appliance contains about 75 percent steel, the old refrigerator can be recycled into cans, new cars, and other steel products. Steel recycling also conserves precious natural resources. According to the Association of Home Appliance Manufacturers, it takes four times more energy to manufacture steel from pure ore as it does to make the same steel from recycled scrap.

After replacing the dishwasher and refrigerator with new, ENERGY STAR-qualified models, there is still another upgrade consumers can make that will not only save money and help the environment, but also improve the overall appearance of a homeowner's kitchen.

What better way to showcase an energy-efficient kitchen's appearance than by installing high-efficiency lighting? Compact fluorescent light bulbs (CFLs) use 75 percent less energy than a traditional incandescent bulb and can be used in a regular light socket without sacrificing any light output.

ENERGY STAR-qualified CFLs last six to ten times longer than incandescent bulbs. So, even though CFLs may cost more up-front, they do not have to be replaced as frequently as incandescent bulbs, so consumers save money over the lifetime of the bulbs. In fact, each qualified CFL can save $35 or more over its lifetime. It takes less than a year for consumers to recover the initial investment of an ENERGY STAR-rated energy-efficient CFL bulb.

CFLs also give off the same light as incandescent bulbs. A 60-watt incandescent has a light output of 800 lumens. A 13- to 15-watt CFL gives the same lumen output and costs approximately $35 less over its lifetime. Consumers would have to replace an incandescent bulb seven times before the 8,000-hour lifetime of the CFL expires.

Additionally, ENERGY STAR light bulbs give off less heat, which reduces the cooling load for a room. With incandescent bulbs, only ten percent of the electricity consumed is converted into visible light, with the remaining 90 percent wasted and released as heat.

CFLs create a chemical reaction among gasses located inside the glass tube, causing phosphors to illuminate. This is a much more efficient way of producing light, and producing much less heat.

CFLs do contain mercury, but the amount of mercury in a CFL is minimal, averaging 5 milligrams. In comparison, older thermometers contain about 500 milligrams of mercury. Nonetheless, it is important that they are disposed of properly.

The Environmental Protection Agency (EPA) recommends that consumers take advantage of available local recycling options for compact fluorescent light bulbs. The EPA is working with CFL manufacturers and major U.S. retailers to expand recycling and disposal options. Consumers can contact their local municipal solid waste agency directly, or go to http://www.epa.gov/bulbrecycling/ or www.earth911.org to identify local recycling options.

Consumers should consider a few factors when replacing incandescent light bulbs with CFLs, such as what shape and size of CFL will fit into a fixture, how much light is needed in a room, and how often a particular light fixture is used. Once all of these factors are considered, there are a variety of shapes and sizes to choose from.

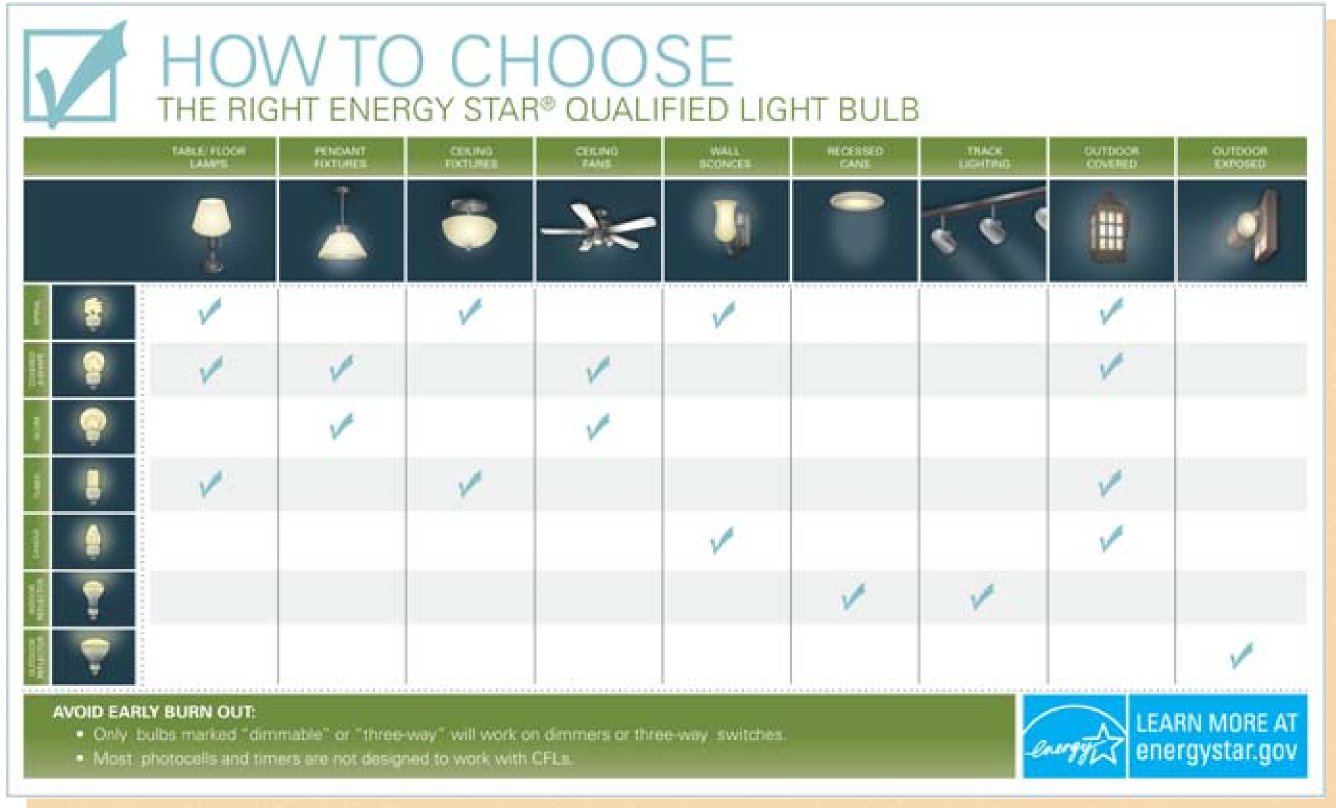
See the *How To Choose* chart to decide which bulb works best for a particular fixture.

To meet ENERGY STAR qualifications, CFLs must meet certain criteria. Among the criteria, CFLs must have a minimum rated

ANNUAL ENERGY STAR SAVINGS PER UNIT

	PRE–1993 SECONDARY REFRIGERATOR RETIRED BUT NOT REPLACED	PRE–1993 SECONDARY REFRIGERATOR REPLACED WITH A NEW ENERGY STAR QUALIFIED COMPACT REFRIGERATOR	PRE–1993 REFRIGERATOR REPLACED WITH A COMPARABLE NEW ENERGY STAR QUALIFIED MODEL
CURRENT kWh	990	990	990
NEW kWh	0	297	451
ANNUAL SAVINGS (kWh)	990	693	539
ANNUAL SAVINGS ($)[1]	$100	$70	$55

[1] Energy costs based on national average electric rate of 10.19¢ from Energy Information Administration (DOE), 2006.



HOW TO CHOOSE
THE RIGHT ENERGY STAR® QUALIFIED LIGHT BULB

	TABLE/ FLOOR LAMPS	PENDANT FIXTURES	CEILING FIXTURES	CEILING FANS	WALL SCONCES	RECESSED CANS	TRACK LIGHTING	OUTDOOR COVERED	OUTDOOR EXPOSED
Spiral	✓		✓		✓			✓	
Covered A-shape	✓	✓		✓				✓	
Globe		✓		✓					
Tube	✓		✓					✓	
Candle					✓			✓	
Indoor reflector						✓	✓		
Outdoor reflector									✓

AVOID EARLY BURN OUT:
- Only bulbs marked "dimmable" or "three-way" will work on dimmers or three-way switches.
- Most photocells and timers are not designed to work with CFLs.

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lifetime of at least 6,000 hours, a start time of less than one second, and a warm-up or "run up" time of less than three minutes.

While all CFLs must meet those standards, the average ENERGY STAR-qualified CFLs exceed these requirements. The average rated life of all ENERGY STAR-qualified light bulbs is 8,000 hours, and the average lifetime if used three hours per day is 7.3 years.

In addition to the number of energy-efficient upgrades available in the kitchen, there are ways to save water and energy in the laundry room as well. The average household does almost 400 loads of laundry each year, consuming about 13,500 gallons of water. An ENERGY STAR-qualified clothes washer saves an average of 7,000 gallons of water a year—or more than half the water savings. Someone's getting soaked.

With the significant water savings comes significant dollar savings as well. Using ENERGY STAR-qualified clothes washers can typically cut utility bills by an average of $50 per year. And, these clothes washers have a larger capacity because there is no agitator, which means fewer loads of laundry. Also, they're gentler on fabric, so clothes last longer and look newer too.

Clothes-washer efficiency is measured by Modified Energy Factor (MEF) and Water Factor (WF). MEF is a comprehensive measure of energy efficiency that considers the energy used by the washer, the energy used to heat the water, and the energy used to run the dryer; the higher the MEF, the more efficient the clothes washer.

WF measures the water efficiency and is calculated as gallons of water used per cubic foot of capacity. The lower the WF, the more efficient the clothes washer.

To meet the current ENERGY STAR criteria, clothes washers must be at least 37 percent more energy efficient than the federal standard, plus they must meet stringent water-efficiency criteria. Current ENERGY STAR criteria requires clothes washers to have an MEF greater than or equal to 1.72 and a WF less than or equal to 8.0. The federal standard is an MEF greater than or equal to 1.26.

There are many options available to consumers to save money on energy bills and cut down on water consumption in the home. While energy-efficient appliances certainly help curtail energy and water usage, there are plenty more changes consumers can make that are easy and effective.

When using a dishwasher or clothes washer, make sure the units are full, to maximize water and energy use, and save money. Instead of rinsing dishes before putting them in the dishwasher, scrape them clean. Most dishwashers are powerful enough to get dishes clean without rinsing them beforehand. This will not only cut water usage, it will save time as well. These are only a couple of the hundreds of ways to maximize a home's energy and water consumption.

ENERGY STAR provides a lot of options outside of the kitchen and laundry rooms as well. Log on to www.energystar.gov for more information on products, practices, and helpful hints for improving a home's energy efficiency. UHD

The Author

Richard H. Karney, P.E., is the U.S. Department of Energy's ENERGY STAR Program Manager.

For more information on this advertiser, circle 14

Kohler Company

Water Conservation Initiatives

Rob Zimmerman

Gary Reber

synopsis

- Residential toilets account for between 25 and 33 percent of indoor water use—people also shower regularly—showers account for about 20 percent of water use in the home—and faucets are another 10 to 15 percent of indoor water use, with most of the remainder used for clothes washers.
- [Kohler's] ability to use very sophisticated computational fluid dynamics software modeling to study flow, rethink tolerances, and redesign trapways gives Kohler engineers and designers an advantage as new regulations further reduce allowable water consumption.

The following interview is with Rob Zimmerman, who is Senior Staff Engineer at the Kohler Company. Rob discusses Kohler's water conservation initiatives. Kohler Company is one of America's oldest and largest privately held companies. Kohler was founded in 1873 and is headquartered in Kohler, Wisconsin. The company is a global leader in the manufacturing of kitchen and bath products, engines and power generation systems, cabinetry, and tile and home interiors.

Gary Reber, *Ultimate Home Design*: What is Kohler's approach to saving water?

Rob Zimmerman, Kohler Company: When it comes to water conservation, the main focus at Kohler is to make sure our customers' experience with our products is not compromised. Thanks to a deep reservoir of engineering and design talent and to the investment in advanced software and other technology about 15 years ago, Kohler has always met—and usually exceeded—all water conservation regulations imposed on the industry over the last 12 years. In fact, products developed at Kohler continually push the performance envelope while transparently saving water. At Kohler, we call this "conservation without compromise."

***UHD* Reber:** What are the trends in water conservation?

Zimmerman: The trends are pretty easy to identify: On the one hand, we're anticipating more regulation of water consumption in more areas of the United States and of the world; and on the other, there is a continued emphasis on technology-based solutions, where Kohler remains well ahead of the industry curve.

Water shortages tend to be regional, sometimes with acute local or municipal shortfalls. The fastest growing regions are affected first. In the United States, that's the West and the Sunbelt; especially California, Nevada, Arizona, Texas, New Mexico, and Florida—plus New England and New York City, primarily because of aging infrastructure. Globally, the countries with the greatest issues are Australia, because they've been in an extended drought; and China, because of their tremendous economic growth.

Most of these regions tend to be, for lack of a better term, water poor. Whether it's surface water or ground water, these regions have fixed water supplies that are being stretched to serve more and more people. Naturally then, water-use regulations are more aggressive in water-poor regions. In the United States, water-use regulations are most stringent in California and the southwest. Globally, it's Australia that's most aggressive, but we're closely watching how China will balance rapid growth against fixed water resources.

A substantial majority of water is consumed by agriculture and industry, but what we call indoor water use—that is, water that is used in homes or commercial buildings—is also important, and, of course, it's in this area that Kohler products can help.

***UHD* Reber:** What consumes the most water in the home?

Zimmerman: In most homes, toilets consume the most water—usually between 25 and 33 percent. That's the reason toilets were mandated to go from 3.0 or more gallons per flush to 1.6 gallons per flush in the Energy Policy act of 1992.

As I've said, the research and development investments that Kohler made to optimize flushing technology have impacted the design of all contemporary Kohler toilets. Reducing water consumption by 20 percent reduces the potential flushing and cleaning energy by 20 percent. Each time you reduce water consumption of a toilet, you have to reengineer how the product works to maintain performance. Our ability to use very sophisticated computational fluid dynamics software modeling to study flow, rethink tolerances, and redesign trapways gives Kohler engineers and designers an advantage as new regulations further reduce allowable water consumption.

***UHD* Reber**: Are more water-use regulations for toilets on the horizon?

Zimmerman: More stringent water-consumption regulations are on the horizon, but in the United States they're likely a few years off, at least. There's a bill pending in California, for example, to phase in a 1.3-gallon-per-flush—gpf, for short—standard for toilets starting in 2009. And the Environmental Protection Agency has announced a program called WaterSense™ (see article on Page 64) that will help consumers identify high-performance, water-efficient toilets that use 1.3 gpf or less. These toilets are referred to as high-efficiency toilets—HETs, for short. That said, Kohler is ready for both California and WaterSense with a number of 1.28 gpf models already on the market. In fact, when it comes to HETs, Kohler is the leader, and nobody in the industry really comes close.

***UHD* Reber:** How does Kohler fit in with LEED®?

Zimmerman: When it comes to water conservation, especially in commercial settings, you hear it all the time. What is it? The LEED (Leadership in Energy and Environmental Design) Green Building Rating System is a voluntary, consensus-based standard for developing high-performance, sustainable "green" buildings. LEED was developed by the U.S. Green Building Council. USGBC members—including Kohler—represent every sector of the building industry, and work to develop and continue to refine LEED.

> "Thanks to a deep reservoir of engineering and design talent and to the investment in advanced software and other technology about 15 years ago, Kohler has always met—and usually exceeded—all water conservation regulations imposed on the industry over the last 12 years."

LEED has become the standard for commercial green building in the United States and Canada—10 percent of all new commercial buildings are projected to be LEED certified by 2010—and LEED has now evolved to include standards for existing buildings and many types of commercial and residential buildings.

Kohler offers a range of water-conserving flushing technologies at a variety of price points and in many styles. They're here now and being used in homes and businesses, making Kohler the industry leader in high-efficiency toilets.

Water conservation is just one of five categories where building designers can earn the needed 26 LEED points to

Kohler MasterShower Eco showerhead

Kohler Pressure-Assist Toilet

Kohler Steward waterless urinal

get a building certified. For example, a 20 percent savings of water earns one point, and a 30 percent savings earns two. Arguably, some of the "easiest" points available are for water conservation, as earning them doesn't add cost or require major modifications. All a designer or engineer has to do is specify plumbing products that—like the Kohler products mentioned in this article—save water without compromising performance.

When you look at water use commercially, the first issue is scale. There may be two or three toilets in a residence, but there may be 10 or 20, or even 200 or 300 toilets in an office complex or at an airport. Naturally, the potential for water savings is tremendously magnified. But in commercial settings there are also urinals, and here again, Kohler technology offers several choices. The standard urinal uses 1.0 gallon per flush. Kohler offers several models of urinals and flush valves that use 0.5 gpf, and the Kohler Steward waterless urinal uses—as the name implies—none. Zero gpf. The potential water savings per fixture per year is about 40,000 gallons!

***UHD* Reber:** How does this waterless urinal work?

Zimmerman: Waterless urinals produced by most other manufacturers utilize a cartridge that requires periodic replacements—it's expensive and messy. But the Kohler Steward features a cartridge-free integral trapway filled with Kohler waterless urinal sealing liquid. This low-density sealant floats in the trapway to provide an odor-blocking barrier but allows liquid waste to pass through it. The urinal is shaped to eliminate splashing and drain virtually all liquid wastes. It's as easy to clean as a bathroom sink.

***UHD* Reber:** Let's return to the home. Other than toilets, where is most water used?

Zimmerman: Residential toilets account for between 25 and 33 percent of indoor water use—we've covered that. People also shower regularly—showers account for about 20 percent of water use in the home. So here's another big opportunity to reduce water use. The same federal law that mandated 1.6 gallons per flush for toilets also required all showerheads to use no more than 2.5 gallons per minute—gpm, for short. It's not hard to reduce the flow on a showerhead, but most low-flow showerheads significantly degrade performance. Plus, a shower is more than a showerhead; there's a thermostatic—or a pressure-balancing valve—behind the wall to maintain a consistent water temperature. If you replace a 2.5-gpm showerhead with, say, an ultra low-flow 1.0-gpm showerhead, you may compromise the functionality of the valve. The result can be temperature shifts that can be startling enough to cause the user to instinctively jump out of the stream and possibly slip and fall. It's both a comfort and a safety issue. But the new 2.0-gpm Kohler MasterShower Eco showerheads and HandShowers—coupled with a precision-engineered Kohler rite-temp valve—reduce

water consumption by 20 percent without sacrificing the quality of water coverage or temperature control.

***UHD* Reber:** And where is the rest of the water used in the house?

Zimmerman: Faucets are another 10 to 15 percent of indoor water use, with most of the remainder used in clothes washers; dishwashers use relatively little water. A standard faucet will use 2.2 gallons per minute, but aerators that add air to the stream for a softer feel and reduced splashing can bring that down to 1.5 gpm. Some aerators reduce water flow to as little as 0.5 gpm. Aerators are great for bathroom faucets, but not as practical in the kitchen where faucets are used for filling pots and other containers.

***UHD* Reber:** What about commercial faucets?

Zimmerman: In commercial settings, the trend is to go with more hands-free faucets and low-flow aerators to save water and improve hygiene. The infrared technology used in first-generation hands-free faucets was easily confused by variations in background lighting, reflections from surfaces, even clothing colors. Sometimes the sensor tripped too easily; sometimes it was it difficult to trip at all.

But new Tripoint technology employed in Kohler Touchless electronic faucets uses technology very similar to that of an auto-focus digital camera to measure distance rather than reflectance to provide highly accurate, dependable performance with very few unintended activations. When your hands "ask" for water, it's delivered. When you don't ask, it isn't. As Tripoint technology penetrates the marketplace, we'll see more and more use of Kohler Touchless faucets in modern commercial applications, including upscale public restrooms and medical facilities. While hands-free technology is generally used commercially, the reliability of the new Tripoint technology is behind an emerging trend in the use of touchless faucets at food prep or clean-up sinks in the residential kitchen for both water-saving benefits and sanitary advantages. All the Kohler technologies and products I've mentioned are part of the Kohler commitment to gracious living, which includes the creation of products that help conserve water without sacrificing performance or design. UHD

The Interviewee

Rob Zimmerman is Senior Staff Engineer at the Kohler Company.

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High-Efficiency Toilets In The New Green Home?

John Koeller & William Gauley

synopsis

- Toilet fixtures have been and remain the foundation of many water conservation programs implemented by water utilities and municipalities throughout North America in this age of water shortages.
- The widely used MaP testing report—in its 10th edition—provides performance and other data on 460 different toilet models.
- High-Efficiency Toilets (HETsa) are fixtures with an effective flush volume that is at least 20 percent below that of a conventional 1.6-gallon fixture, for an effective flush volume of 1.28 gallons (4.8 L) per flush or less.

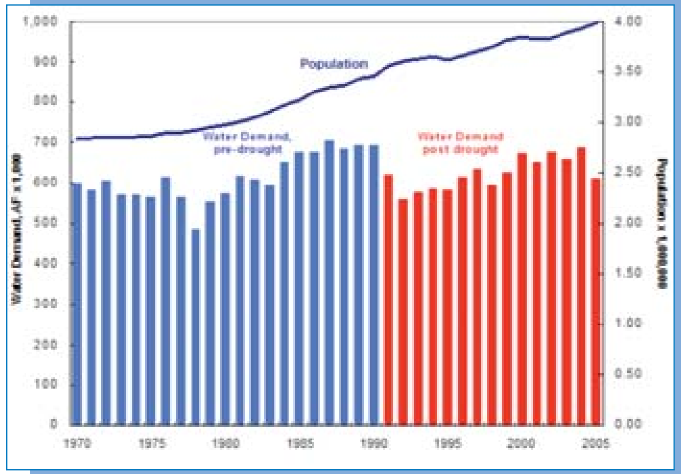


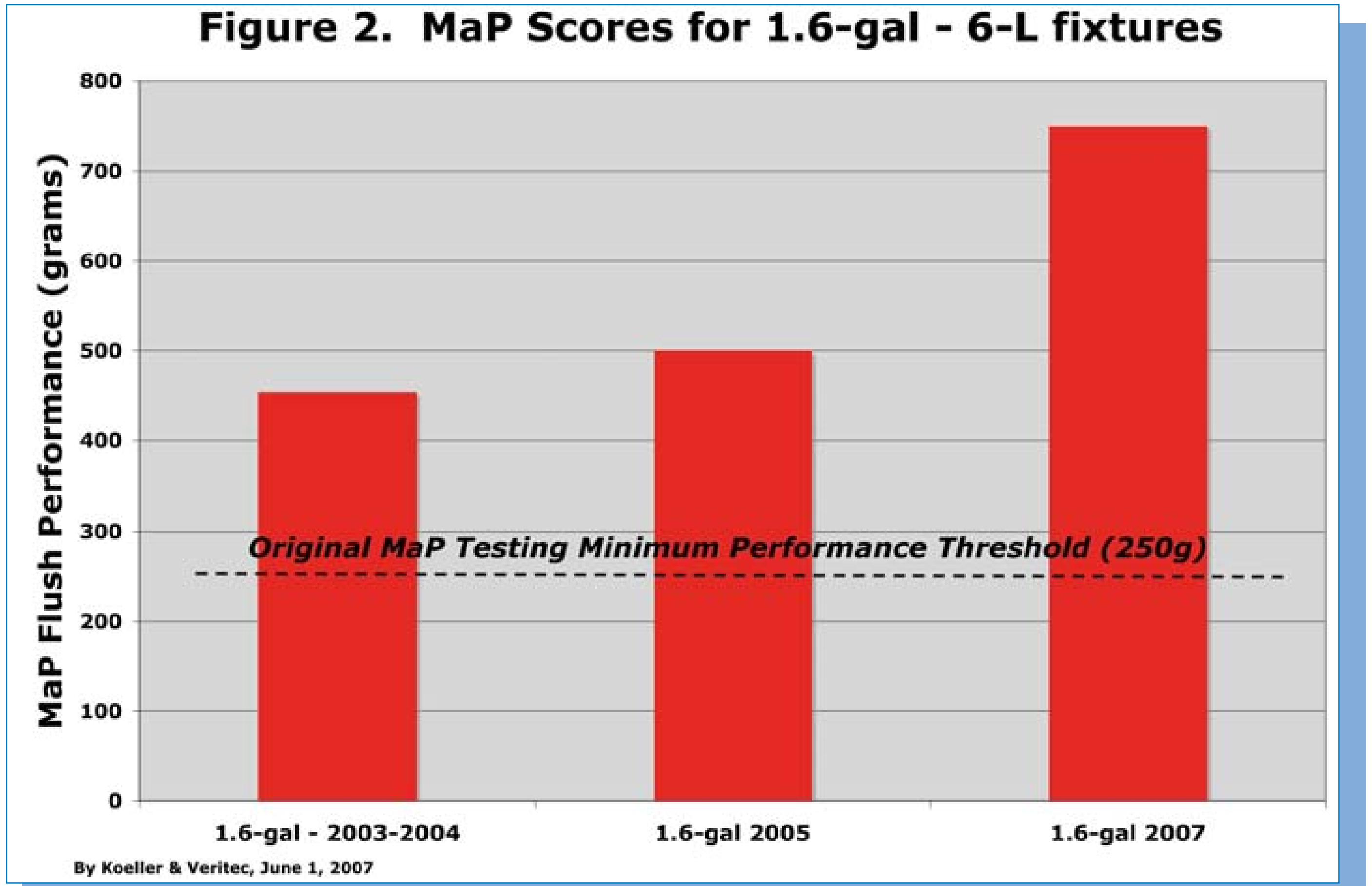
Figure 1

Back in the March/April 2006 issue of *Ultimate Home Design*, we gave you an introduction to Maximum Performance (MaP) testing of toilet fixtures, including the flushing performance data on 214 different fixture models. Today, the North American trend is toward the new High-Efficiency Toilets (HETs), so a little background on that category of product is our focus.

Background

First, a little bit of history. According to recent studies, toilet flushing in the typical home is responsible for about 27 percent of indoor water use.[1] In older homes with the older leaking fixtures, the consumption figure is well above 30 percent, more than the shower, clothes washer, or other indoor uses. So, whether focused on remodeling or on new home design and construction, selecting the right toilet fixture can go a long way toward achieving the ultimate "green."

Toilet fixtures have been and remain the foundation of many water conservation programs implemented by water utilities and municipalities throughout North America in this age of water shortages. Up until the late 1990s, the programs most always provided incentives for residential customers to replace their aging toilet fixtures with the efficient 1.6-gallon (6-liter) models. These programs were extremely successful in curtailing water use in many water-short areas.



For example, Figure 1 compares the total water consumption and population growth of the City of Los Angeles over a 35-year period from 1970 through 2005. Note that with a population increase of approximately 1.2 million during that period, water use remained constant! Los Angeles attributes this amazing accomplishment to their very effective water-conservation initiatives, primarily to the replacement of more than one-million toilets in the residential sector.

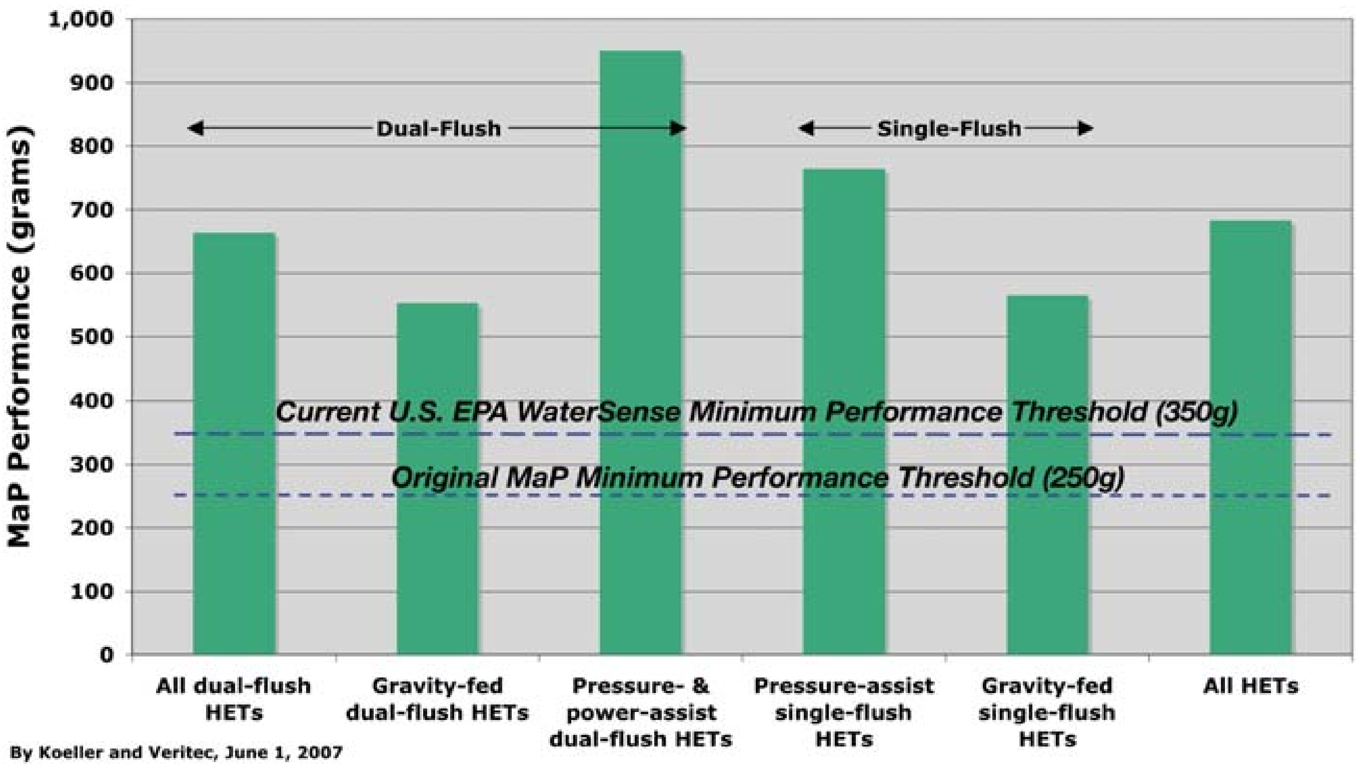
Maximum Performance (MaP) Testing

During the 1990s, however, it was a well-known fact that many of the 1.6-gallon (6-L) toilet fixtures produced before 1998 were not stellar performers when it came to flushing waste (…and that may be putting it mildly!!). This situation led the water-utility industry (which was funding millions of toilet-replacement rebates and then hearing customers complain about their new fixtures) to embark upon their own testing and evaluation scheme. This, of course, was the genesis of MaP testing, developed in 2003 with funding from 22 water utilities and related interests. Today, the widely used MaP testing report—in its 10th edition—provides performance and other data on 460 different toilet models (mostly tank type), and is freely available for your examination and download at: www.cuwcc.org/maptesting.lasso.

One of the interesting fallouts from MaP was the plumbing industry's response to independent testing of their products.[2] While they were initially very reluctant to embrace the new MaP testing protocol, they later came to support it and use it in their own new product development. As such, manufacturers immediately began to improve toilet performance through better tank and bowl hydraulics, innovative flush valves, and other measures. As these product developments made their way into the marketplace, performance improved, MaP scores began to increase, and the number of complaints from customers declined. Clearly, better toilet fixtures are now being produced by the industry.

1 AWWA Research Foundation and Aquacraft, Inc., Mayer, Peter and DeOreo, William, 1999. Residential End Uses of Water.
2 All toilet fixtures installed in North America must go through a prior certification process conducted by independent laboratories. That process involves a testing protocol that is not at all rigorous when it comes to removing waste from the fixture. Many plumbing and water-efficiency professionals believe that inadequacies of that test is the primary reason that so many poor-performing fixtures have entered the marketplace since 1992. MaP testing, however, was designed to "raise the bar" on performance and help decision-makers, giving the consumer and specifier the necessary independently developed performance information that would discriminate among all of the fixtures offered for sale in the marketplace.

Figure 3. MaP Scores for HETs (1.28 gal - 4.8 L and less)



By Koeller and Veritec, June 1, 2007

High-Efficiency Toilets (HETs)

However, even before MaP, a second market path was being explored by the plumbing industry, that of fixtures that flush at something less than 1.6 gallons (6-L). In early 1999, the first HET was introduced into the North American marketplace. An HET is a fixture with an effective flush volume that is at least 20 percent below that of a conventional 1.6-gallon fixture. That is, the effective flush volume is 1.28 gallons (4.8 L) per flush or less.[3]

The first HET to arrive in North America was a gravity-fed dual-flush design, which had already been a proven technology available in the Australian marketplace for over 10 years. Dual-flush fixtures offer the user two flush options, a full 1.6-gpf option to remove solid waste and a reduced (0.8 to 1.1-gpf) flush option for liquids only. Users choose the appropriate option each time they flush. Today, 17 manufacturers offer 85 different models of dual-flush HETs,[4] all of which are suited to residential installation.

The second category of HET is the single-flush pressure-assist toilet. Water utilities in California conducted field trials of the first prototypes of these fixtures in 2001. By 2003, a variety of models were entering the North American marketplace. These fixtures range in flush volume between 0.9 and 1.1-gpf and have proven themselves to be excellent performers both in laboratory testing and, more importantly, in “real world” residential applications. Since only one flush volume is available, the user is not required to make a choice, thereby, eliminating the “behavioral” aspect of dual-flush. Today, 13 manufacturers[5] offer 37 different models of this technology.

Some critics have cited the pressure-assist fixtures as being too noisy for residential installations. However, the newest products are much quieter than the older pressure-assist units from the 1990s. In fact, some gravity-fed toilets have a more dominant noise curve than today’s pressure-assist HETs! Evidence of customer satisfaction with this HET technology is the record of over 5,000 such fixtures being installed in Redwood City, California homes in the past several years. In the city’s toilet-replacement program, customers are given a choice between a conventional gravity-fed 1.6-gallon (6-L) fixture and a pressure-assist single-flush 1.0-gallon (3.8-L) HET. The majority of residents have chosen the HET, fully aware that the HET might have a slightly sharper noise profile than the conventional toilet.[6]

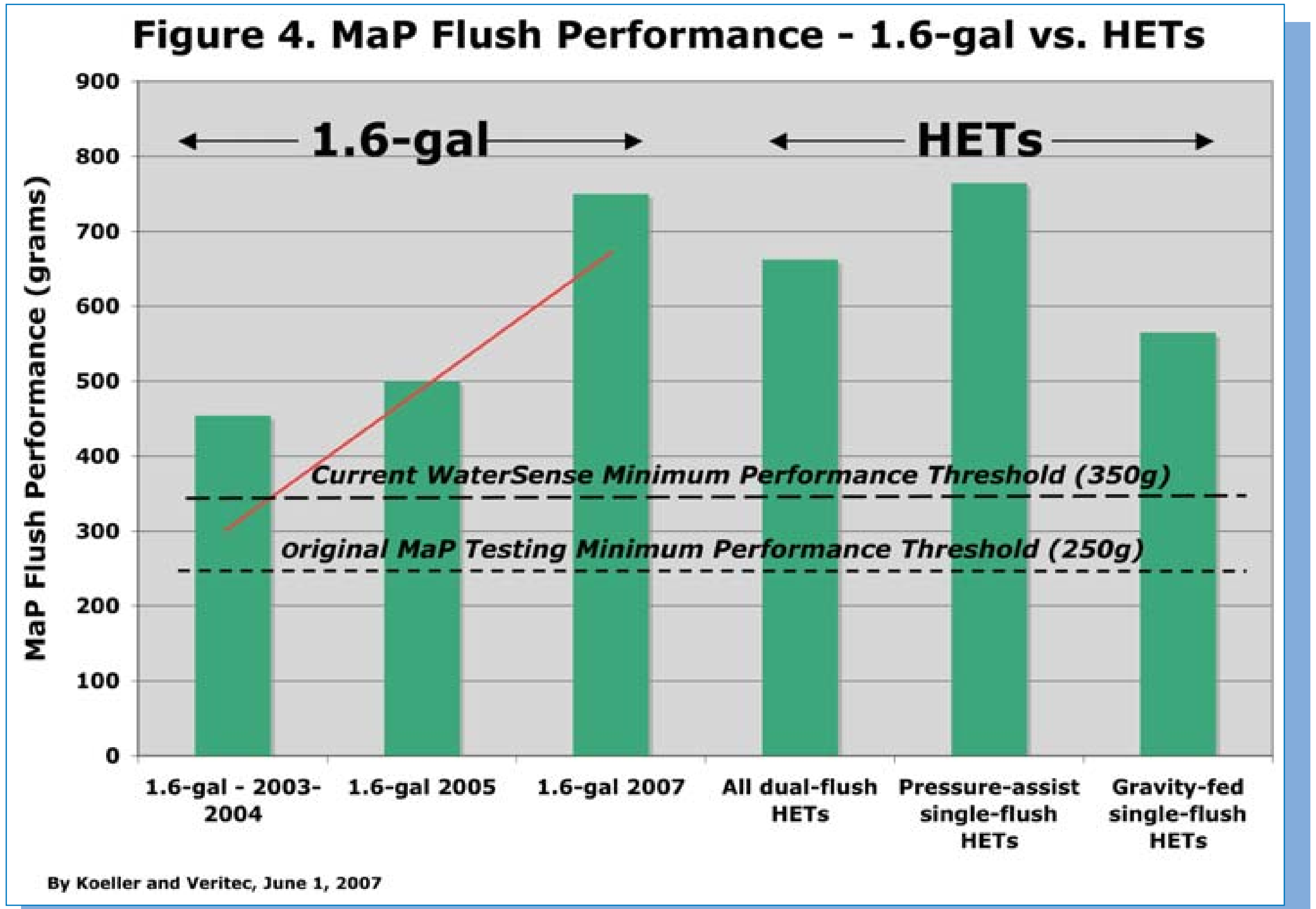
3 Field studies in the U.S. and Canada showed that in residential applications, the effective, or weighted average, flush volume is approximately 1.25-gpf, thereby, qualifying them as an HET.
4 Of the total of 85 different models, 68 are gravity fed and 17 are pressure-assist units.
5 Many of these manufacturers offer both dual-flush and single-flush HETs.
6 Redwood City’s program information may be accessed at: www.redwoodcity.org/publicworks/water/toiletprogramindex.html.

Table 2. MaP Score Of High-Performance HETs (700s and above) - Sorted By Manufacturer

Type of toilet fixture:
- (green) 4-L (1.1-gal) Pressure-assist
- (pink) 6-L (1.6-gal) Pressure- or power-assist (full flush option on a dual-flush fixture)
- (white) Gravity-fed & Vacuum-assist

Make	Model Name	Model Number	MaP Flush Performance (grams of solid waste removed in a SINGLE flush)	Qualified to meet U.S. EPA WaterSense Specification	1-piece or 2-piece model	Flush Valve-Flapper size (in.)	No flapper / Non-traditional flapper	Round Front (R) or Elongated (E) bowl	ADA-Comfort Height-Right Height	High-Efficiency Toilets (HETs): Dual-Flush	Single-Flush Max 1.1-G (4-L) Pressure-Assist	Single-Flush Max 1.28 G (4.8 L) Gravity
American Standard	FloWise EL	2073.014: 3018 bowl, 4023.014 tank	750	WS	2	3	*	E				HET
Caroma	Adelaide 270 Cube EL	834000 bowl, 814790 tank	700	WS	2	-	*	E		HET		
Caroma	Adelaide 270 Standard EL	834000 bowl, 814328 tank	700	WS	2	-	*	E		HET		
Caroma	Bondi 270 EL ADA	609120 bowl, 726350 tank	900	WS	2	-	*	E	*	HET		
Caroma	Caravelle 1-Piece EL ADA	989668	800	WS	1	-	*	E	*	HET		
Caroma	Caravelle 270 EL ADA	609120 bowl, 629435 tank	800	WS	2	2	*	E	*	HET		
Caroma	Caravelle 270 RF ADA	989770: 609177 bowl, 629435 tank	800	WS	2	-	*	R	*	HET		
Caroma	Royale 270 EL ADA	609120 bowl, 624530 tank	850	WS	2	-	*	E	*	HET		
Caroma	Royale 305 EL	609130 bowl, 629530 tank	850	WS	2	-	*	E		HET		
Caroma	Sydney 270 EL ADA	609120 bowl, 622320 tank	1,000	WS	2	-	*	E	*	HET		
Caroma	Sydney 305 RF Standard	609151A bowl, 622320 tank	1,000	WS	2	-	*	R		HET		
Crane	Economiser One EL	31945: 3825 bowl, 31612 tank	1,000		2	-		E			HET	
Crane	Economiser One EL ADA	31948: 3828 bowl, 31612 tank	1,000		2	-		E	*		HET	
Crane	Economiser One RF	31944: 3824 bowl, 31612 tank	1,000		2	-		R			HET	
Eljer	Power 1-G EL	091-7625: 131-7625 bowl; 141-7600 tank	800		2	-		E			HET	
Eljer	Power 1-G EL ADA	091-7675: 131-7675 bowl; 141-7600 tank	800		2	-		E	*		HET	
Gerber	Ultra Dual Flush EL	DF-21-312: 21-372 bowl, DF-28-380 tank	1,000	WS	2	-		E		HET		
Gerber	Ultra Dual Flush EL	DF-21-314: 21-372 bowl, DF-28-384 tank	1,000	WS	2	-		E		HET		
Gerber	Ultra Dual Flush EL ADA	DF 21-318: 21-377 bowl, DF-28-380 tank	1,000	WS	2	-		E	*	HET		
Gerber	Ultra Dual Flush EL ADA	DF-21-324: 21-377 bowl, DF-28-384 tank	1,000	WS	2	-		E	*	HET		
Gerber	Ultra Dual Flush EL ADA (rear discharge)	DF-21-325: 21-375 bowl, DF-28-380 tank	1,000	WS	2	-		E	*	HET		
Gerber	Ultra Dual Flush EL ADA (w/bedpan lugs)	DF 21-319: 21-329 bowl, DF-28-390 tank	1,000		2	-		E	*	HET		
Gerber	Ultra Dual Flush RF	DF-21-302: 21-342 bowl, DF-28-380 tank	1,000	WS	2			R		HET		
Gerber	Ultra Dual Flush RF	DF-21-304: 21-342 bowl, DF-28-384 tank	1,000	WS	2	-		R		HET		
Gerber	Ultra Flush EL ADA	EF 21-318: 21-377 bowl, EF-28-380 tank	800	WS	2	-		E	*		HET	
Gerber	Ultra Flush EL ADA	EF-21-312: 21-372 bowl, EF-28-380 tank	800	WS	2	-		E	*		HET	
Gerber	Ultra Flush EL ADA	EF-21-314: 21-372 bowl, EF-28-384 tank	800	WS	2	-		E	*		HET	
Gerber	Ultra Flush EL ADA	EF-21-324: 21-372 bowl, EF-28-384 tank	800	WS	2	-		E	*		HET	
Gerber	Ultra Flush EL ADA (rear discharge)	EF-21-325: 21-375 bowl, EF-28-380 tank	800	WS	2	-		E	*		HET	
Gerber	Ultra Flush EL ADA (w/bedpan lugs)	EF-21-319: 21-329 bowl, EF-28-390 tank	800		2	-		E	*		HET	
Gerber	Ultra Flush RF	EF-21-302: 21-342 bowl, EF-28-380 tank	1,000	WS	2	-		R			HET	
Gerber	Ultra Flush RF	EF-21-304: 21-342 bowl, EF-28-384 tank	1,000	WS	2	-		R			HET	
Kohler	Cimarron Eco-Smart EL ADA	K-3496-HE: 4286 bowl, 4634-HE tank	800	WS	2	3		E	*			HET
Kohler	San Raphael Power Lite EL	K-3398 Power-Assisted **(DISCONTINUED MODEL-replaced by K-3393)**	850		1	-	*	E		HET		
Kohler	San Raphael Power Lite EL ADA	K-3393 Power-Assisted	1,000	WS	1	-	*	E	*	HET		
Kohler	Sterling Karsten RF	402025: 402021 bowl, 402023 tank	800	WS	2	2	*	R		HET		
Kohler	Wellworth Pressure Lite EL	K-3531: 4303 bowl, 4484 tank	1,000	WS	2	-		E			HET	
Kohler	Highline Pressure Lite EL ADA	K-3519: 4304 bowl, 4484 tank	1,000	WS	2	-	*	E	*		HET	
Mansfield	EcoQuantum EL	147 bowl, 119 tank	1,000	WS	2	-		E		HET		
Mansfield	EcoQuantum EL ADA	148 bowl, 119 tank	1,000	WS	2	-		E	*	HET		
Mansfield	EcoQuantum RF	146 bowl, 119 tank	1,000	WS	2	-		R		HET		
Mansfield	QuantumOne EL	147 bowl, 153 tank	1,000	WS	2	-		E			HET	
Mansfield	QuantumOne EL	149 bowl, 153 tank	1,000	WS	2	-		E			HET	
Mansfield	QuantumOne EL ADA	148 bowl, 153 tank	1,000	WS	2	-		E	*		HET	
Mansfield	QuantumOne RF	146 bowl, 153 tank	1,000	WS	2	-		R			HET	
Niagara	Ecologic EL ADA HET (Flapperless)	N2225E: N2225EB bowl, N2225T tank	800	WS	2	-	*	E	*			HET
Toto	Aquia EL	CST414M: CT414 bowl, ST413M tank	800	WS	2	2		E		HET		
Toto	EcoDrake EL ADA	CST744EL: C744EL bowl, ST743E tank	900	WS	2	3		E	*			HET
Vitra	Evergreen (formerly Corina) Dual Flush Comfort EL ADA	5074 bowl, 5055 tank	800	WS	2	2		E	*	HET		
Vitra	EverGreen RF ADA	5196 bowl, 5402 tank	800	WS	2	2		R	*			HET
Vortens-Lamosa	Rhodas EL ADA (HET)	3123V bowl, 3436V tank	1,000		2	-	*	E	*	HET		
Vortens-Lamosa	Tornado EL	3138 bowl, 3468 tank	700		2	-		E			HET	
Vortens-Lamosa	Tornado EL ADA	3134 bowl, 3468 tank	1,000		2	-		E	*		HET	
Western Pottery	Wrangler One EL	8432 PF: 432 PF bowl, ULF-T4 tank	1,000		2	-		E			HET	
Zurn	EcoVantage Dual Flush EL	Z5572	800		2	-	*	E		HET		
Zurn	EcoVantage Dual Flush EL ADA	Z5562	1,000		2	-	*	E	*	HET		
Zurn	EcoVantage EL	Z5571	800		2	-	*	E			HET	
Zurn	EcoVantage EL ADA	Z5561	1,000		2	-	*	E	*		HET	

RF – Round-front toilet bowl
EF – Elongated-front toilet bowl
S - Special bowl design
ADA-Meets bowl-height requirements of Americans with Disabilities Act; does NOT imply that fixture meets any other ADA requirements.
WS - Qualified (certified) to the U.S. EPA WaterSense specification for high-efficiency toilets



The third category of HET is the gravity-fed single-flush toilet functioning at 1.28-gallon (4.8-L). Like the pressure-assist version, only one flush option is available to the user. Today, 20 different models are available from six manufacturers, but many more are expected before the end of 2008.

Finally, a fourth category is that of flushometer valve HETs recently introduced for non-residential applications. A total of 16 models from three manufacturers are currently available.

To date, over 45,000 HETs have already been installed in California residences, many in new homes as an element of a green building program or incentive!

An up-to-date listing of all 158 HETs offered in the North American marketplace may be found at: www.cuwcc.org/toilet_fixtures.lasso#HETs. Over the next 15 months, we expect that the number of HET models available in the marketplace will grow by as much as 50 percent, as some manufacturers introduce many new models and others change the majority of their focus from conventional 1.6-gallon (6-L) models to HETs.

Flush Performance

Since MaP testing began in 2003, the flush performance of all toilet fixtures has improved quite dramatically. Figure 2 illustrates the average MaP score (grams of waste removed from the fixture in a single flush) in 2003 to 2004, 2005, and 2007 for conventional 1.6-gallon (6-L) toilets. In the brief period from 2003 to 2007, the average flush performance has increased from approximately 450 grams to nearly 750 grams[7]—a very significant improvement.

Figure 3 and Table 1 show the average flush performance of the various types of HET design technologies.

Figure 4 compares the performance data found in Figures 2 and 3. Note that the HET fixtures currently being tested are fully competitive on flush performance with their conventional 1.6-gallon counterparts. In fact, the average flush performance of today's products, whether 1.6-gallon or HET, far exceeds what would be required in the real world. Any fixture

7 The minimum acceptable waste-removal score, as determined from medical research conducted by that industry and used in developing the MaP test protocol, was set at 250 grams. This waste removal must be achieved in a single flush of the fixture. See the full MaP report for further details: www.cuwcc.org/maptesting.lasso.

WATER conservation

Table 1. HET Average MaP Performance

HET Design Technology	Average MaP Score
All dual-flush HETs	663
Gravity-fed dual-flush HETs	552
Pressure- and power-assist dual-flush HETs	950
Pressure-assist single-flush HETs	765
Gravity-fed single-flush HETs	565
All HETs	683

that meets a consistent performance level of 350 grams or more will satisfy the user.

(And, by the way, when MaP testing was performed on brand new 3.5-gallon (13-L) fixtures—which have been outlawed in the U.S. since 1994—the average waste removal score was below 200 grams! So, well-designed hydraulics within the fixture appears to be far more important than the volume of water delivered to the bowl!)

However, many HETs easily surpass the 350-gram threshold, some scoring as high as 1,000 grams! Table 2 lists (in alphabetical order by manufacturer) those "super performers" of 700 grams[8] and more that are suited to residential installations.[9]

A Well-Deserved Commendation!

The plumbing industry must be strongly commended for the improvements in fixture-flushing performance (due, in part, to the focus on realistic test media in the MaP protocol) that have occurred in the last few years. While some "marginal performers" may still occasionally be found in the marketplace; the consumer, specifier, contractor, and others can now make fixture choices with confidence based upon available and authoritative flush-performance information that did not exist in the 1990s .

EPA's WaterSense℠ Program Labels HETs

In early 2004, the U.S. Environmental Protection Agency (EPA) began developing the WaterSense℠ water-efficient product market enhancement program (including product labels) similar to their highly successful ENERGY STAR® program for energy. (See page 36.) Initially, toilets were not to be included in the program because of the high level of controversy left over from the early 1990s and, in some cases, still surrounding them. But with the groundwork already completed on MaP testing, product evaluation, and related specifications, it became apparent that toilets, which offer perhaps the greatest potential for indoor water use reduction, would be a prime candidate for the new EPA Program. As such, the EPA decided not only to include toilets in their program, but they decided to kick-off the WaterSense℠ program with toilets as one of the headliners.

One of the first decisions by the EPA was to "label" only HETs rather than include 1.6-gallon (6-L) models. They chose to use the same definition developed earlier by the water utilities—toilets with effective flush volumes of no more than 1.28 gallon[10] (4.8-L), 20 percent less than the current maximum of 1.6-gallon (6.0-L).

In 2006, the EPA rolled out its draft HET specification (including MaP testing but with a 350-gram minimum performance threshold) to interested stakeholders for comment. The final specification was released in January 2007, and product testing and labeling began immediately thereafter. This endorsement of HETs by the EPA is further evidence that this technology is viable. Currently, there are 75 toilet fixture models certified (through independent third-party testing) to the WaterSense specification. Transformation of the market is underway.

The EPA's home page for WaterSense may be accessed at www.epa.gov/watersense/.

The final WaterSense HET specification can be downloaded at http://www.epa.gov/watersense/docs/spec_het508.pdf.

Drainline Transport Of Waste

Movement of waste in the drainline within the home has been cited by some as a concern where HET flush volumes are as low as one gallon, i.e., will clogging and backups occur as water volumes are reduced? To deal with this issue, we conducted a very comprehensive laboratory study using the realistic MaP media and nine different toilet flush technologies to evaluate solid waste movement in drainlines of different diameters and slopes. This 2005 study showed that, in all cases, for typical residential installations, there was sufficient water to move the waste to the sewer.[11]

The EPA had similar concerns about drainline transport of wastes as they analyzed HETs for the WaterSense program. Before releasing the HET performance specification, additional laboratory tests were conducted that satisfied the EPA that

8 It is important to note that the MaP test represents only ONE measure of flush performance, that of evacuating sinking solid waste from the fixture in a single flush. Customers also have performance expectations for bowl cleaning, noise, splashing and other factors; these are NOT measured in the MaP testing protocol.
9 We have excluded flushometer valve toilets from this listing, since they are designed for heavy-duty commercial and institutional applications.

10 Rounded by the EPA to 1.3-gpf.
11 Gauley, Bill, Veritec Consulting, Inc. and Koeller, John, 2005. Evaluation of Water-Efficient Toilet Technologies to Carry Waste in Drainlines, Final Report, Revision 1, March 11. Download the full study report from the California Urban Water Conservation Council at this link: www.cuwcc.org/toilet_fixtures/Drainline_Report_05-03-11.pdf.

HETs do provide sufficient water to transport solid waste to the sewer.

It is important to note that, for certification, HETs must meet the very same drainline waste transport requirements as all other toilets sold in the United States and Canada. However, all toilets, regardless of flush volume, may experience problems when installed in existing locations with degraded or damaged drainline systems, e.g., root intrusion, sagging or broken lines, buildup of solids, etc., or in buildings with very long drainline runs and no additional sources of wastewater near the toilet fixture.

Recommending An HET Model For The "Ultimate Home"

Although our policy is to not recommend specific toilet models, we do have some suggestions for builders, architects, specifiers, contractors, and consumers to consider when choosing a toilet fixture.

1. Gravity-fed models fitted with 3-inch (diameter) flappers (or flush valves) tend to outperform models with the more traditional 2-inch flappers.

2. Pressure-assisted models tend to offer a high level of flushing performance and sustained water savings, though, they are also typically a little louder and, in some cases, more expensive.

3. Performance and price do NOT go hand in hand—some inexpensive models perform very well. Conversely, some very costly models are exceedingly poor performers.

4. Rely on MaP test results for flush performance instead of the less meaningful claims you may hear at trade shows or from sales personnel (e.g., "model can flush 30 golf balls," "model has fully glazed trapway," etc.), which are usually little more than marketing gimmicks.

5. Consider specific models rather than specific manufacturers—many manufacturers offer both high-performing and low-performing models. UHD

The Authors

If you have questions about toilet fixtures for your new "ultimate home," first consult the product news section of the California Urban Water Conservation Council's Web site: http://www.cuwcc.com/toilet_fixtures.lasso.

If you have additional questions or comments about HETs, MaP testing, or water-utility incentive programs that encourage the installation of HETs, contact either one of us:

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Your Solar Estate:
Healthy, Wealthy, And Easy

Scott Cronk

synopsis

- Today's solar energy systems are based upon proven technologies, backed by major companies with long-term warranties, and installed by experienced professionals with minimal disruption to your home or life.
- Any investment you make improving your home's energy efficiency will reduce the size of solar equipment investments needed to supply energy for your home.
- The main types of solar energy systems used on homes include solar electric (PV, or photovoltaics) to produce electricity, and solar thermal systems.

  The increase in appraisal value for a home is about twenty (20) times the annual reduction in operating costs due to energy-efficiency measures.

Today, solar energy systems are finding their ways onto the homes of many Americans. These are relatively easy home improvements that add value to your home and help create a healthier living space. It's a more efficient, comfortable home that can "live" even when the power utility is down, and thrive when utility prices are rising.

Today's solar energy systems are based upon proven technologies, backed by major companies with long-term warranties, and installed by experienced professionals with minimal disruption to your home or life. Thereafter, your utility bills will be reduced and, perhaps more importantly, hedged against an uncertain energy future. And you will be adding value to your home. The appreciation in home value is significant and can even equal that of the installation expense.

Healthy, Comfortable, Efficient Living Spaces

Energy-efficient homes are quiet, draft-free, comfortable living spaces. And any investment you make improving your home's energy efficiency will reduce the size of solar equipment investments needed to supply energy for your home. Therefore, while developing your solar energy installation plans, also consider your energy uses. Reducing your energy use and improving the efficient use of energy in your home is the most economically sound way to improve your home's energy situation. Energy-efficiency improvements might include improved insulation and

windows, compact fluorescent lighting (CFL), high-efficiency heating and cooling, on-demand water heating, and ENERGY STAR® appliances. These home improvements come with rapid financial paybacks and help improve the overall comfort of your home.

Look at your recent utility bills. What patterns do you see? Are you experiencing high heating bills in winter or high cooling bills in summer? If so, consider improving the efficiency of your space heating and/or cooling.

Also, understand how your utility bills are determined. Some utilities charge in "tiers." This means the more energy you use, the higher your energy cost on a per unit basis (for example, per kilowatt per hour [kWh] of electricity and therm of natural gas). Energy-efficiency improvements can take you out of, or minimize, high-tiered rates, thus lowering your overall cost for energy. Or you may have time-of-use (TOU) charges. This means the rate your utility company charges you changes by season, day, or time of day. Generally, TOU is broken down into peak, part-peak, and off-peak rates. Peak rates are the most expensive and off-peak the least expensive. If you have TOU rates, by altering your energy-use patterns, you can dramatically reduce your energy charges. Consider using major appliances (like clothes washers) during off-peak times (usually evenings and weekends).

There are financial incentives and tax credits for energy-efficiency improvements. Most utilities offer free energy audits and online tools to help you determine what energy-efficiency improvements will help you most. There are also many professionals that specialize in home-energy audits and energy-efficiency improvements. Many of these same organizations also design and install solar energy systems.

Resources:

• DSIRE (www.dsireuse.org) is a free, online database that offers summaries of energy efficiency and solar equipment incentives that may be available to you.
• Home Energy magazine (www.homeenergy.org) and the American Council For An Energy-Efficient Economy (www.aceee.org) offer articles on the best practices for creating a clean, healthy, energy-efficient home.

Which Solar Technology?

The main types of solar energy systems used on homes include solar electric (PV ,or photovoltaics) to produce electricity, and solar thermal systems. Solar thermal systems use the sun's energy to produce usable heat. Solar thermal systems are used in a variety of applications, including solar domestic hot water (SDHW), solar pool and spa heating, and solar space heating. Solar space heating is usually provided by water—heating systems that boost radiant floor-heating systems or ground-source heat pumps. But space heating can also be provided by direct air systems in an active or passive format. Active systems capture, store, and distribute heat provided by the sun. Passive systems generally utilize optimally designed windows and shading (for summer) to allow natural sunlight to enter living areas and heat the space.

Generally, solar thermal systems have a lower up-front cost and a faster financial payback as compared to PV systems. This is because solar thermal systems are efficient at converting the sun's rays to heat energy for your home. The most economically attractive form of solar equipment installation is for pool or spa heating. The next most economically attractive is a solar domestic water-heating system.

PV systems, to be financially attractive, usually rely upon purchase incentives. There are Federal tax credits, and in many state and local markets PV systems have great incentives to help lower their up-front cost.

Resource:

• Visit www.findsolar.com to help you determine what to expect from these various systems, including incentives that may be available to you.

Wealthy

Choosing to improve the energy efficiency of your home and installing a solar energy system is also a wise financial decision. The value of your home will appreciate and cash outflows and expenses will be reduced. Utility rates, solar incentive programs, and home values vary from market to market, so you'll need to model your situation to see how solar adds up for you. Most solar professionals now use modeling software to estimate solar system performance and financial performance. You, as a consumer, can use free tools like www.findsolar.com to begin the process.

Financials: Home Appreciation

The Appraisal Journal found that "the increase in appraisal value for a home is about twenty (20) times the annual reduction in operating costs due to energy-efficiency measures." These energy-efficiency improvements can come from the more efficient use of energy (like a new heating system) or through the installation of a solar energy system (which effectively reduces the utility energy demands of your home). In essence, a $1,000 reduction in your annual energy bills can result in a $20,000 increase in the value of your home upon

resale. The rationale is that money not spent on energy bills can be applied to an equity loan payment.

Pacific Gas & Electric (California) compares solar investment to other home improvements as follows:

Financials: Cash Flow

Today, in almost all cases, solar energy systems have a financial payback period significantly shorter than the expected life of the solar energy system. And, in markets with strong solar incentives, many solar installations are cash positive from the start. This means the utility bill savings will be greater than the loan payments for the solar system. Even in markets with little or no solar incentives, many people find any additional out-of-pocket expenses are modest (about the cost of a cable TV subscription). Once the solar system loan is paid off, the utility bill savings result in a positive cash flow.

Global Climate Change And Solar Energy Systems

Global climate change is a hot topic today. Individual beliefs in the causes, effects, and solutions to global climate change vary, but installing solar energy systems helps to reduce greenhouse gas emissions. There is another important reason you may want to add solar energy systems to your home: Solar energy can hedge your life against change and uncertainty, which global climate change and fossil-fuel use exacerbate.
Our lives are increasingly impacted by a dynamic, global political environment. Energy prices are fluctuating and generally expected to rise. Data over the past several years shows that utility prices have risen faster than the consumer price index. Energy price inflation is not only felt at the gas pump, but also in electric, natural gas, and other fuel rates. Tax and trade systems are responding to a variety of social, energy, and environmental issues. It is a period of unprecedented change and uncertainty.

Solar energy systems work by "fixing" your cost of energy. It is an investment guaranteed to provide many years of energy, without feeling the full effects and impacts from the global energy market. By dividing the cost of a solar system by its lifetime energy production, you get the "levelized cost of energy." For example, a $20,000 system that produces 133,000 kWh over its life equates to about $0.15 per kWh. Compare this to what you think the cost of electricity may be in 5, 10, or 15 years. With solar energy systems you can minimize the uncertainty of utility price escalations.

FIND SOLAR
PRE-SCREENED SOLAR PRO

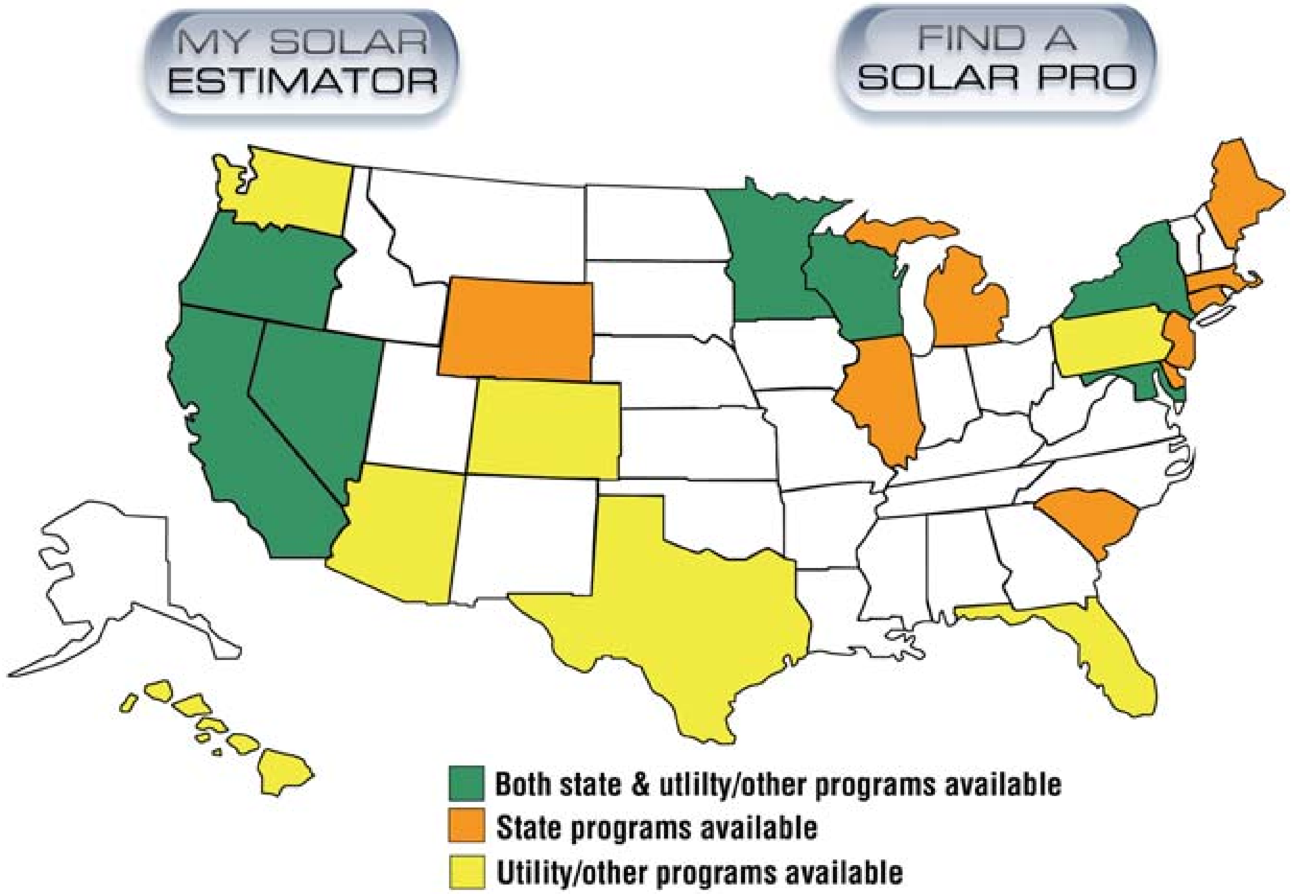
Mature Technology

Solar technology is based upon mature technology products backed by large corporations offering multi-year warranties (typically 25 years for PV). Solar equipment is increasingly considered a "commodity" in today's marketplace. There are many manufacturers in which to choose in a competitive environment ,where customer demand often prevails. Prices have dropped sharply over the past couple of decades, and have now more or less leveled off. In 2006 there was actually an increase in the price of solar equipment, largely due to demand outstripping supply, worldwide. As new equipment manufacturing capacity continues to come online, and solar equipment sales continue to increase, the prices are expected to drop. But for all practical purposes, now is as good a time as any to make a solar equipment investment, especially when one considers the tax and purchase incentives available.

Easy Installation And Trouble-Free Operation

Determining the cost and benefits of solar energy is relatively easy, as is the design and installation process. Once installed, you should find your solar system provides years of reliable service with very little need for maintenance.

Pre-Solar Bill (Month)	Net Cost	Equity Increase	% Return
$102	$20k	$20k	103%
$209	$39k	$57k	145%
$379	$58k	$102k	176%
Other Home Improvements			
Deck Addition	$6.3k	$6.7k	104%
Bath Remodel	$10.1k	$9.1k	89%
Window Replacement	$9.6k	$8.2k	85%
Kitchen Remodel	$44k	$33k	75%



Explore With Free Web Tools: www.Findsolar.com

New Web-based tools available today allow you to easily determine the cost and benefits of installing a solar energy system. Perhaps one of the most comprehensive, free Web tools available is www.Findsolar.com. It is easy to use and gives you a powerful tool to help evaluate a solar energy system for your home. Estimators for solar electric systems, solar domestic hot water (SDHW), and solar pool and spa heating are available. This Web site also offers a database of about 1,000 solar professionals across the United States. You can match your interests to these Solar Pros and send them e-mail inquiries directly through Findsolar.com. Extensive profiles are available, including customer ratings and reviews of each Solar Pro. This is a free public service made possible by the American Solar Energy Society (www.ases.org).

Today there are many tax and other financial incentives available to help reduce installation costs. There are Federal tax credits available, and other incentives vary by state and local. The incentive terms also differ by consumer type—residential, commercial, nonprofit applications. And new financial instruments are beginning to become offered, which can provide future earning power: "Renewable Energy Certificates" (RECs, sometimes called "GreenTags") are certificates that document the carbon you've saved (greenhouse gases). New markets are starting to open up, which allow RECs to be traded, like stocks and other equity instruments. As REC trading comes online, you will have another financial advantage as a solar homeowner.

Findsolar.com includes a summary of incentives available in your area and links to other resources to help you learn and explore in more detail.

What To Expect

Other home improvements, such as a bath or kitchen remodel, can be highly disruptive to your home and life. But the work involved with installing a solar energy system is accomplished largely on the outside of your home and is significantly less disruptive. There is usually no need to move furniture, curtain off areas, or deal with dust and debris inside your home. Most systems can be installed and commissioned in less than a week, and often in just a couple of days.

Financing your system can be done with home equity lines of credit or other similar, standard, loan instruments. And at least one company now offers loans specific to solar energy systems (www.cleanpowerfinance.com).

A large number of solar energy systems have been installed over the past few years, and building permit departments are usually experienced and rather streamlined in their permitting process. The paperwork required to receive your tax credits and incentives can be somewhat more complex. And if you are installing a PV system, a "net-metering" agreement may be required. This is an agreement you make with your utility company that allows you to "sell" your solar energy back ("spin the meter backwards"). Most Solar Professionals will handle the building permit, financial incentive, utility agreements, and other paperwork for you. All you'll need to do is sign the forms so they can be submitted and processed. Tax credits and deductions are rather straightforward and can be processed with tax software or by your tax preparer.

Once your solar installation is complete, there is very little maintenance or operating expense. You'll be reminded of your new solar system when you come home after work, and see it glimmer in the sun. You'll be reminded of it when you get your new, lower energy bill. You'll be reminded of it when the power utility has blackouts and only your home remains powered. And you'll be reminded of your solar system when neighbors and friends stop by to have a look and learn from you.

Perhaps, once or twice a year you may want to clean off your solar panels to keep them top producers. This can easily be done when you maintain gutters or perform other regular seasonal roof-related work.

You'll love living in your new solar-powered home. And if you do decide to sell your solar home, you should realize the asset value of your solar system. UHD

The Author

Scott Cronk is President of Energy Matters LLC, a firm specializing in Web-based tools to help streamline the renewable energy industries. He lives in a solar-powered home in Santa Rosa, California and can be reached at info@energymatters.net.

For more information on this advertiser, circle 15

The Easy Way To Design A Water-Efficient Home:

Look For The WaterSense℠ Label

Benjamin H. Grumbles

EPA WaterSense℠

synopsis

- Protecting and preserving the nation's water supply is critical to our economy, the environment, and human health. In the last five years, nearly every region of the country has experienced water shortages; by using water efficiently now we will help ensure water supplies for our children.
- WaterSense is a voluntary partnership program sponsored by EPA to promote water-efficient products and practices across the country.
- The WaterSense label makes it easy to find products and services that save water while ensuring performance. WaterSense-labeled products are independently certified to use at least 20 percent less water and perform as well as or better than conventional models in that product category.
- WaterSense already labels high-efficiency toilets and certification programs for irrigation professionals. Water-efficient faucets will soon follow in early 2008.

An important step of green home-building involves doing your homework and finding the best products and services to meet your sustainability goals. For the growing circle of home-owners and home builders concerned with designing living spaces that use less energy, water, and other resources, the legwork can be daunting.

With more and more eco-branded products entering the market, how do you determine which ones really use fewer resources and perform well? WaterSense™, a partnership program sponsored by the U.S. Environmental Protection Agency (EPA), is here to help you navigate the waters of efficient plumbing and irrigation practices and products.

As the new national brand for water efficiency, the WaterSense program labels products that are at least 20 percent more water efficient and perform as well as or better than conventional models. To earn the label, products are certified by third-party laboratories to meet the EPA's rigorous criteria for both efficiency and performance.

High-efficiency toilets (HETs) are the first WaterSense-labeled products to hit the market. In January 2007, the EPA announced its final HET specification, and already more than 60 labeled models are available. Bathroom sink faucets and faucet accessories such as aerators should be available in stores early next year.

Why Water Efficiency?

Water is one of the least-appreciated resources on the "green" agenda. Many question why we need to save water in the United States, when supplies are plentiful and wastewater is treated and replenished. But Americans use more water each day than people in many other countries combined.

The EPA launched WaterSense in 2006 as a way to respond to the United States' increasing demand for water and finite water supplies. Between 1950 and 2000, the U.S. population nearly doubled. In that same period, however, public demand for water more than tripled! Furthermore, in the last five years, nearly every region of the country has experienced water shortages. At least 36 states are anticipating local, regional, or statewide water shortages by 2013, even under non-drought conditions. Using water more efficiently, without sacrificing convenience or performance, is a simple way to reduce our water use.

Initially, WaterSense is targeting residential water-using products. Our homes consume more than half of publicly supplied water in the United States, more than what is used by either business or industry. By helping consumers identify water-efficient products that work well, WaterSense can help all of us make every drop count.

Savings Inside And Out

Incorporating WaterSense-labeled products into the construction of a new home is an ideal way to save water and money on utility bills. For example, installing WaterSense-labeled HETs, which use no more than 1.28 gallons per flush, can reduce water used for toilets by about 60 percent and save about 16 percent of total indoor water use. Savings for a typical household would be more than 10,000 gallons per year—enough to fill a backyard swimming pool!

The EPA's WaterSense initiative is taking the savings outside, too, by partnering with irrigation professionals who know how to help homeowners save water and money, while maintaining a beautiful, healthy landscape. When you consider that as much as 50 percent of the seven billion gallons of water used outdoors daily goes to waste due to wind, evaporation, improper system design, installation or maintenance, WaterSense irrigation partners can make a big difference.

WaterSense labels certification programs for landscape irrigation designers, auditors, and installation and maintenance professionals that emphasize water-efficient techniques. Professionals who successfully complete one of these certification programs are then eligible to become WaterSense irrigation partners. To date, there are nearly 300 WaterSense irrigation partners across the United States.

Specifying a WaterSense irrigation partner on your next landscaping project will not only help ensure a healthy landscape that doesn't waste water or your or your client's money—it may help you meet your green building goals. New homes rating system criteria drafts from both the National Home Builders Association (NHBA) and U.S. Green Building Council (USGBC) program reference the use of WaterSense irrigation partners.

More With Less: WaterSense℠-Labled Toilets

Whether remodeling a bathroom or constructing your dream home, these WaterSense-labeled high-efficiency toilets, or "HETs," can help you save water and potentially reduce your utility bill. If just half of the approximately five million new toilets purchased for new home construction each year were WaterSense-labeled high-efficiency toilets, we would save 2.1 billion gallons of water annually. That's enough water to supply 22,000 homes for a year. To date, more than 60 labeled toilets are available.

WaterSense Meets EPA Criteria

Please note that many WaterSense-labeled toilets are sold in two parts, with the tank and bowl sold separately. Both components need to be combined in order for the HET to perform as certified to earn the WaterSense label. For more information, please consult the following Web site: http://www.epa.gov/watersense/pp/find_het.htm.

WaterSense-Labeled New Homes

In addition to working with existing green building programs, WaterSense has been developing a national specification for water-efficient new homes. This will help reduce the guesswork for forward-looking homeowners who want to incorporate water efficiency into their custom construction, or architects and builders who want to promote water efficiency to home buyers.

In 2008, the EPA plans to release its technical specification for a WaterSense new homes-labeling program. Using existing product and partner criteria for the residential construction market, WaterSense will label new homes to help builders differentiate themselves—and point the way for consumers looking to build with water efficiency in mind. A WaterSense-labeled home will include WaterSense-labeled products and feature landscape irrigation services performed by WaterSense irrigation partners.

For more information about the program or a full list of WaterSense-labeled products and irrigation partners, please visit www.epa.gov/watersense. UHD

The Author
Benjamin H. Grumbles is the Assistant Administrator for Water at the U.S. Environmental Protection Agency.

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